



## **Meso- and Micro-scale Modelling in China: Site inspection trip to NE China (Dongbei)**

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# Meso- and Micro-scale Modelling in China: Site inspection trip to NE China (Dongbei)



Risø-I-Report

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Risø-I-2900(EN)  
June 2010





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**Abstract (max. 2000 char.):**

As part of the “Meso-Scale and Micro-Scale Modelling in China” project, also known as the CMA component of the Sino-Danish Wind Energy Development Programme (WED), a site inspection trip to NE China (Dongbei) was carried out by China Meteorological Administration, the provincial meteorological administrations of Liaoning, Jilin and Heilongjiang, and Risø DTU in June of 2009. A total of 13 sites with instrumented 70- and 100-m masts in the three provinces of Dongbei were visited; the present report summarises the findings of the site inspection teams. The main results are descriptions and documentation of the meteorological masts and site conditions. For each site, the location and magnetic declination have been determined, as well as the boom directions on the mast. Elevation maps have been constructed to show the surrounding terrain and photos taken to document the land use. Finally, the observed wind rose and wind speed distribution for the year 2009 are shown.

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# 1 Introduction

As part of the “Meso-Scale and Micro-Scale Modelling in China” project, also known as the CMA component of the Sino-Danish Wind Energy Development Programme, a site inspection trip was carried out by China Meteorological Administration, the provincial meteorological administrations of Liaoning, Jilin and Heilongjiang and Risø DTU in June 2009.

A total of 13 sites featuring instrumented 70- and 100-m masts were visited; the present report summarises the findings of the site inspection teams. Figure 1 shows the positions of 15 project sites in Dongbei (NE China; consisting of the provinces Liaoning, Jilin and Heilongjiang).



*Figure 1. Overview map of Dongbei showing the location of the 15 meteorological masts referred to in the text (Image © 2010 Europa Technologies, NFGIS, ZENRIN, US Dept. of State Geographer and Google Inc.).*

## 1.1 Mast positions

The positions of the meteorological masts were determined using a Garmin eTrex GPS receiver. Three readings were taken (corresponding approximately to the three legs of the mast) and subsequently averaged to find the position of the mast, see Table 1.

*Table 1. Mast coordinates and elevations. The datum used is WGS 84; elevations are determined by the WAsP flow model from SRTM3 maps with 5-m height contours.*

Province	Longitude	Latitude	Elevation	Easting	Northing	UTM
Mast ID	[°E]	[°N]	[m a.s.l.]	[m]	[m]	zone
<b>Liaoning</b>						
01	120.27608	41.10905	342	271280	4554439	51
02	121.65722	39.73201	134	384932	4398875	51
03	123.99825	41.16924	1017	583740	4558025	51
10	121.74360	42.31208	395	396457	4685191	51
L5	121.83645	42.46533	315	404342	4702100	51
<b>Jilin</b>						
04	122.27773	44.52714	168	442608	4930678	51
05	123.65746	44.94102	136	551871	4976609	51
06	124.10508	43.94166	185	588686	4865987	51
11	130.53070	42.60573	15	625561	4718169	52
J5	124.01715	44.61596	155	580701	4940793	51
<b>Heilongjiang</b>						
07	133.87547	48.21450	40	416464	5340753	53
08	127.64503	47.66755	327	398278	5280240	52
09	125.34413	45.74241	147	215611	5071930	52
12	129.57772	46.30003	95	544492	5127546	52
H5*	130.33285	46.64002	312	602009	5166025	52

\* The position of Mast H5 has not been verified yet and is therefore considered preliminary.

The elevations of the mast positions were determined by the WAsP flow model (Mortensen *et al.*, 2009) from 5-m height contour elevation maps derived from Shuttle Radar Topography Mission (SRTM) 3 arc-second data.

## 1.2 Bearings and directions

The magnetic declination at each site was estimated using the [magnetic declination calculator](#) provided by NOAA's National Geophysical Data Center (NGDC). All magnetic bearings ( $M$ ) have been transformed to true bearings ( $T$ ) using  $T = M + D$ , where  $D$  is the magnetic declination. The magnetic declination is westerly (and therefore negative) for all the sites in Dongbei, i.e. the magnetic north  $M$  lies to the west of geographic north  $T$  (when seen from the site).

The alignment of the wind direction vanes were originally done using a compass; the recorded wind directions are therefore referenced to magnetic north and they have been transformed accordingly as part of the present analysis.

### 1.3 Mast characteristics

The design and characteristics of the 70- and 100-m masts are described elsewhere. Photos taken during the site inspection trip may serve to verify that actual installations are done according to these master designs.

### 1.4 Surrounding terrain

The terrain surrounding each masts is shown in panoramic photographs for each station; starting from 000°, photos were taken clockwise for every 30°.

### 1.5 Elevation maps

Elevation maps for each site were constructed from Shuttle Radar Topography Mission (SRTM) 3 arc-second data, using Surfer 9. Overview maps cover 20×20 km<sup>2</sup>, with 20- or 10-m height contours; detailed site maps cover 2×2 km<sup>2</sup>, with 5-m contours. These maps are shown for each station in the descriptions below. The maps are preliminary and must be verified against other elevation information – especially close to the masts.

### 1.6 Land-use map

The land-use was checked against print-outs of Google Earth imagery and photos were taken of characteristic land-use types. Preliminary land-use maps may be constructed from this information, but these should be verified on basis of ordinary topographical maps, if and when such maps can be made available.

### 1.7 Observed wind climate

The observed wind climate, i.e. the wind rose and wind speed distribution, is shown for stations where this information was available at the time of publication. The observed wind climates were constructed using the WAsP Climate Analyst, version 1.1. **Error! Reference source not found.** in the Appendix shows the status of the meteorological measurements conducted with Risø DTU equipment at the time of writing.

### 1.8 Other resources

The CMA component of the WED programme runs a collaboration web site where the results of the site inspection trip will be uploaded:

- Site inspection report
- Photographs from the site inspection trip
- WAsP-compatible elevation maps for each station
- WAsP workspaces for each station

The present report and these data are meant to serve as a starting point for a much more thorough analysis of the elevation and land-use characteristics at each site. A Risø DTU mission to CMA in Beijing was carried out in December 2009 with the purpose of establishing the final topographical descriptions for the microscale flow modelling. These descriptions have been used for the microscale modelling (Mortensen *et al.*, 2010).



## 2 Chaoyang, Heiniuyingzixiang (M01)

M01	120.27608°E	41.10905°N	342 m	E 271280 m	N 4554439 m	UTM 51
-----	-------------	------------	-------	------------	-------------	--------

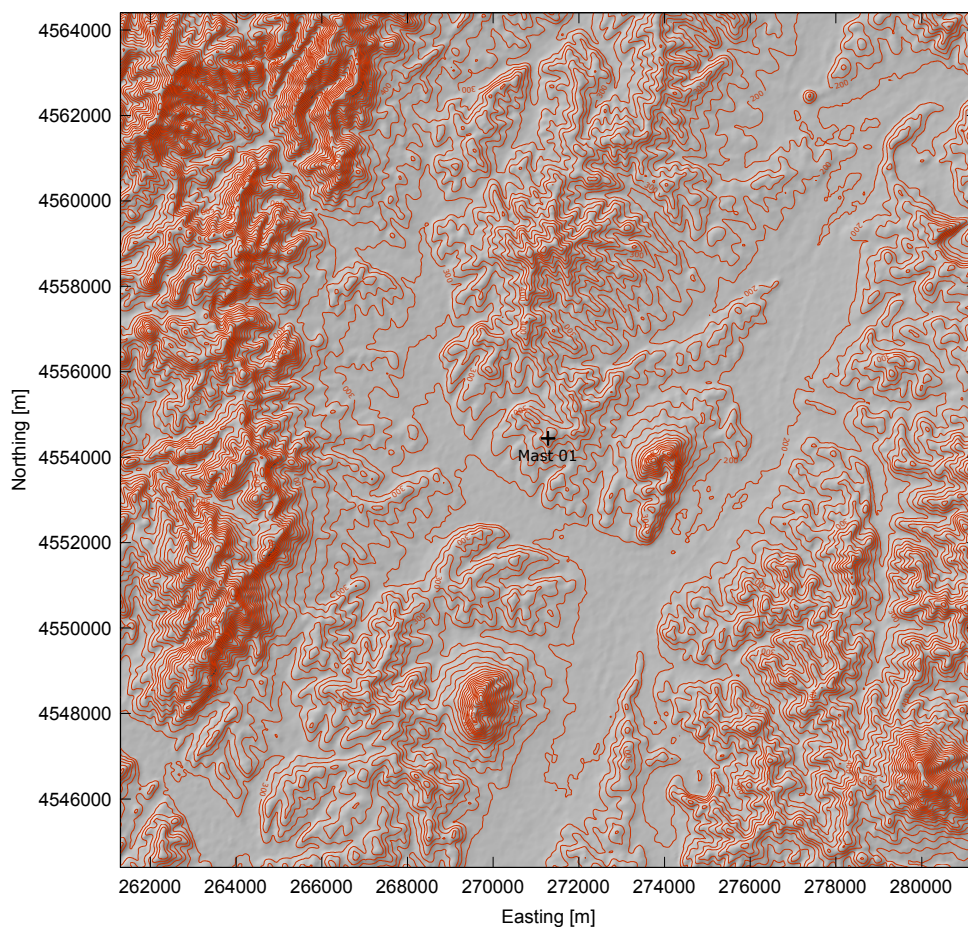


Figure 2. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours. The ruggedness index for the site is 0%.

### 2.1 Site characteristics and observations

The declination is  $7^\circ 53' \text{ W}$  changing by  $0^\circ 4' \text{ W}$  per year;  $8^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	312°	012°	312°

	Leg 1	Leg 2	Leg 3
Guy wire directions	041°	164°	282°

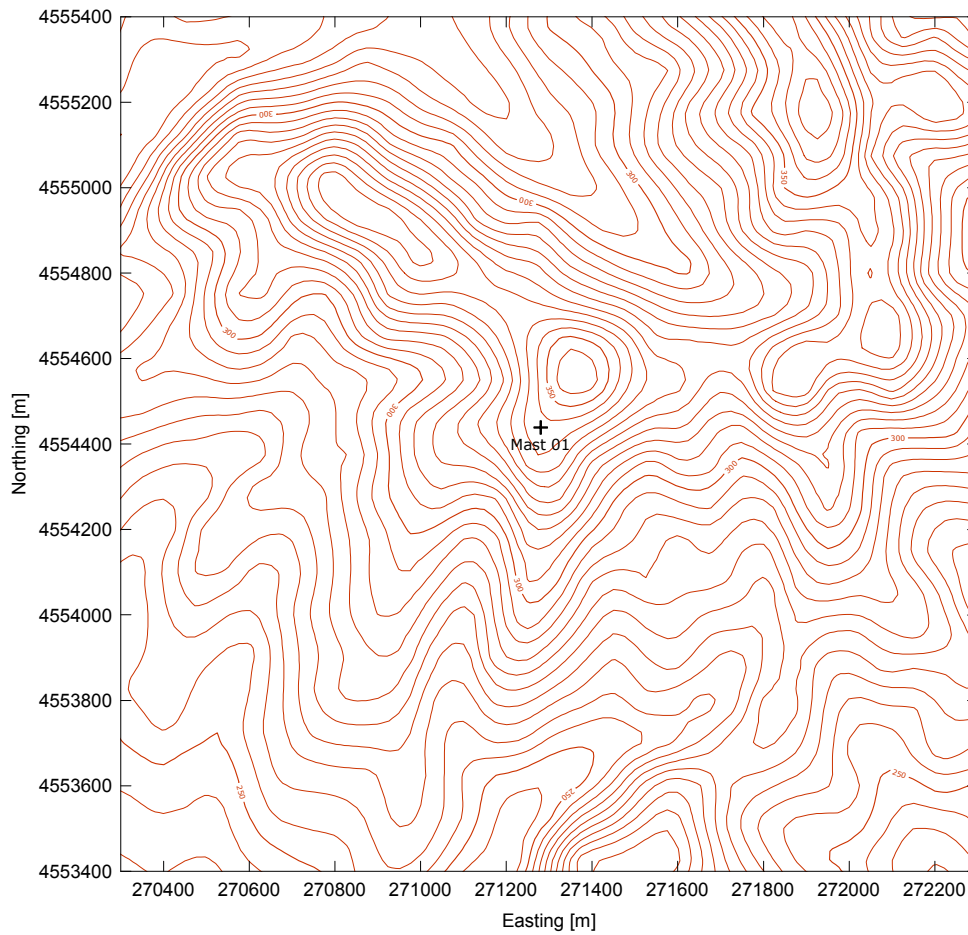


Figure 3. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m height contours.

## 2.2 Observed wind climate

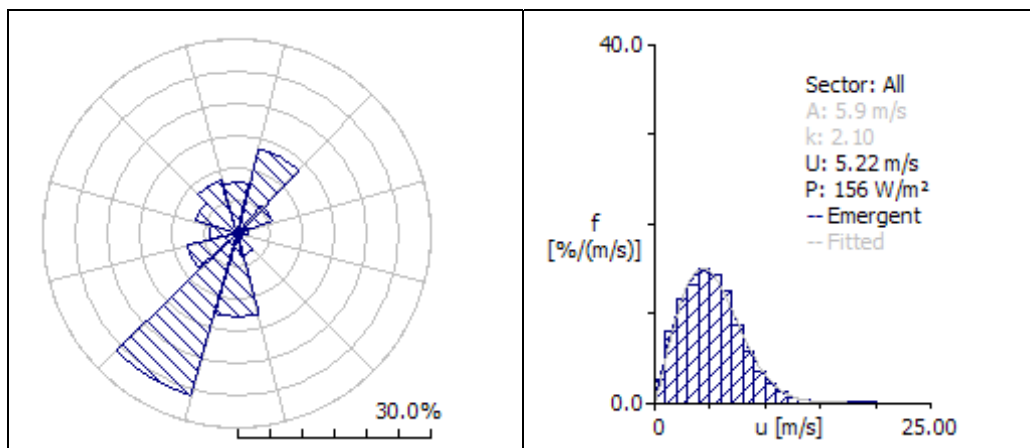


Figure 4. Wind rose and wind speed distribution for Chaoyang at 70 m a.g.l. The number of observations is 52560 and the recovery rate for 2009 is 100%.





060



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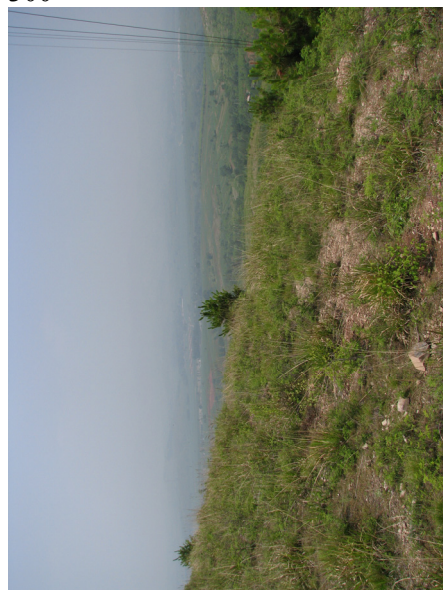
180



330



300



270

### 3 Wafangdian, Fuzhoucheng, Xiaopengcun (M02)

M02	121.65722°E	39.73201°N	134 m	E 384932 m	N 4398875 m	UTM 51
-----	-------------	------------	-------	------------	-------------	--------

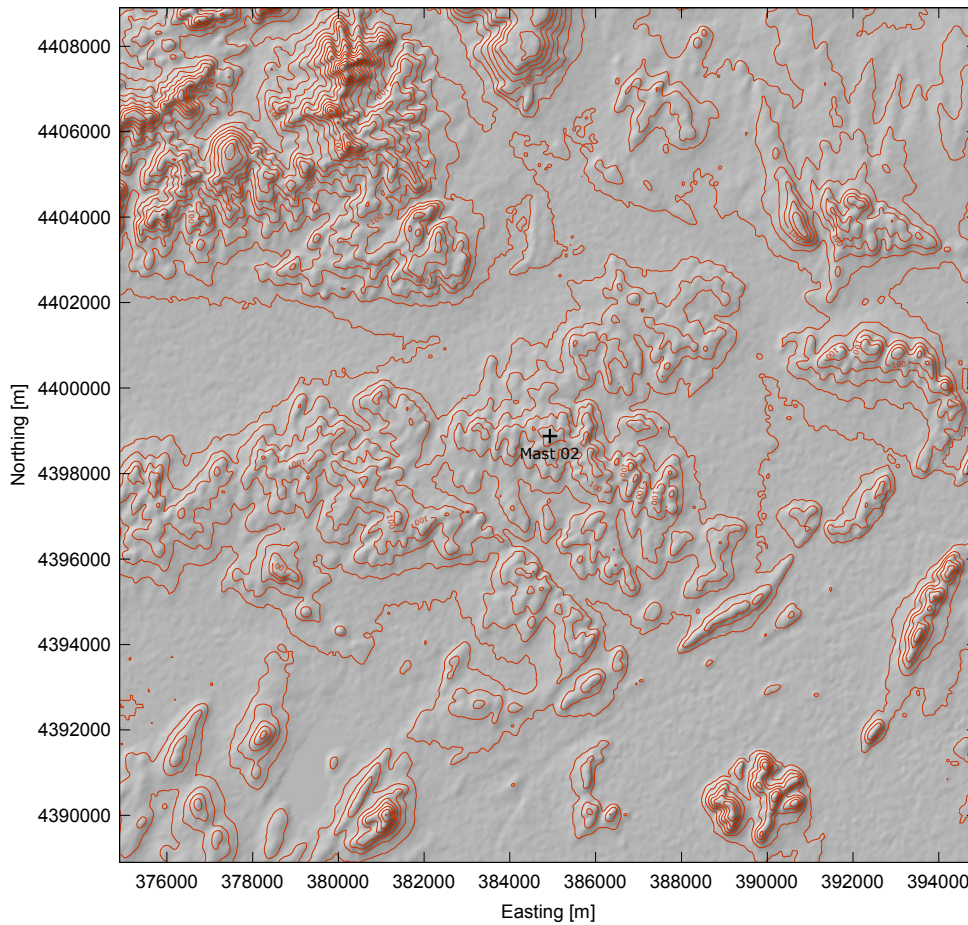


Figure 5. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours. The ruggedness index for the site is 1.5%.

#### 3.1 Site characteristics and observations

The declination is  $7^\circ 49' \text{ W}$  changing by  $0^\circ 4' \text{ W}$  per year;  $8^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	$239^\circ$	$118^\circ$	$299^\circ$

	Leg 1	Leg 2	Leg 3
Guy wire directions	$027^\circ$	$147^\circ$	$267^\circ$



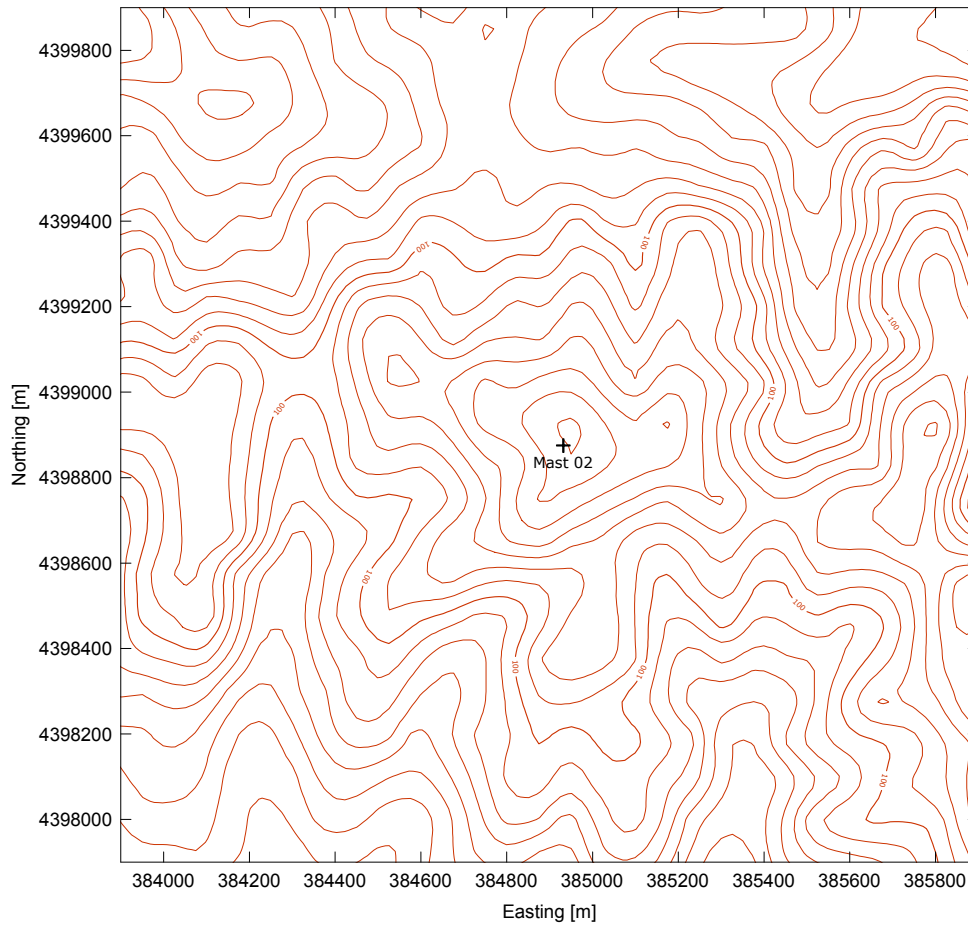


Figure 6. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m height contours.

### 3.2 Observed wind climate

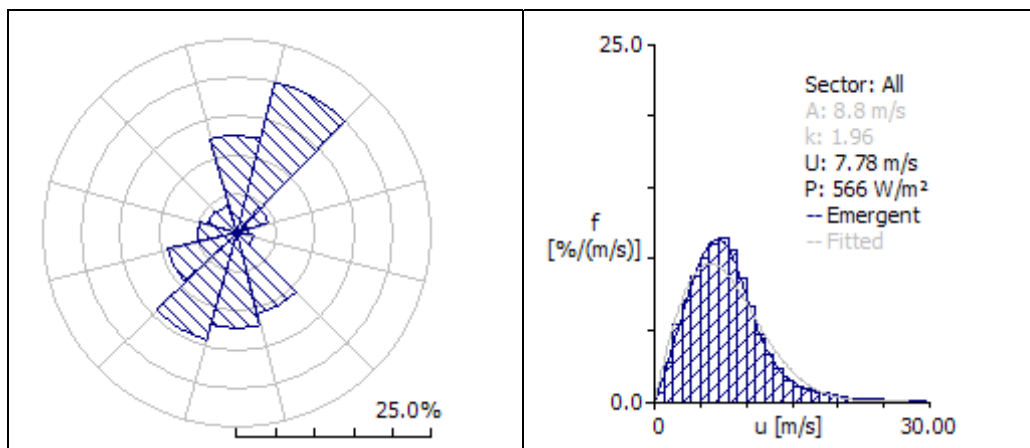


Figure 7. Wind rose and wind speed distribution for Wafangdian at 70 m a.g.l. The number of observations is 52557 and the recovery rate for 2009 is 100%.



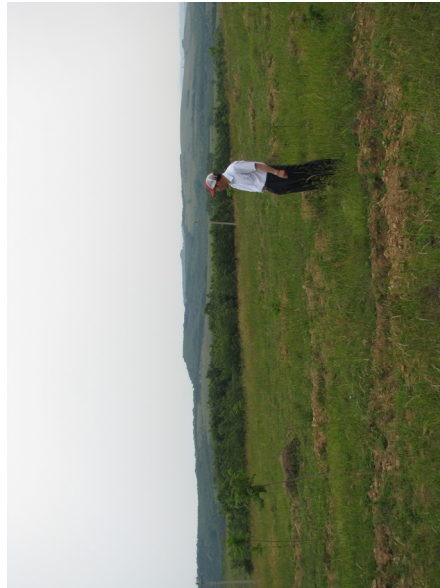
060



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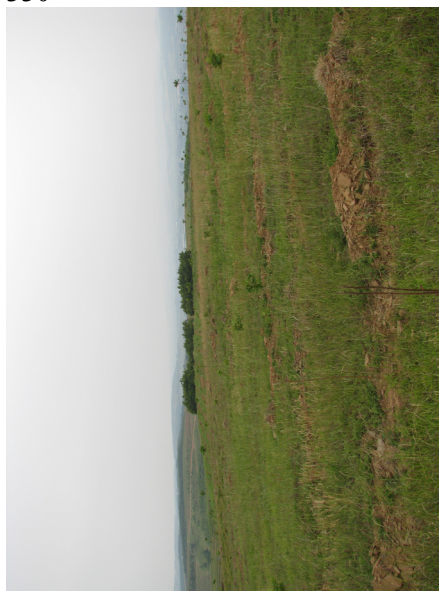
240



330



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270

## 4 Benxi, Dongyingfang, Xiaosipingcun (M03)

M03	123.99825°E	41.16924°N	1017 m	E 583740 m	N 4558025 m	UTM 51
-----	-------------	------------	--------	------------	-------------	--------

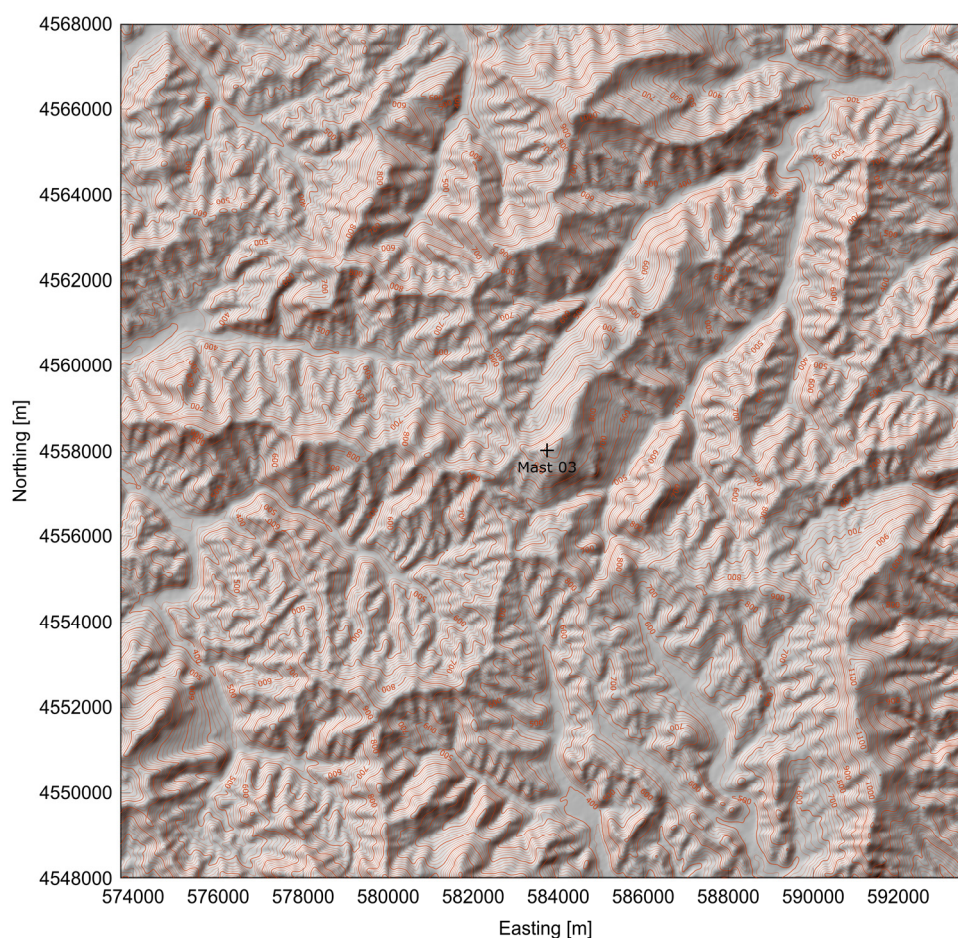


Figure 8. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours. The ruggedness index for the site is 31.3%.

### 4.1 Site characteristics and observations

The declination is  $8^\circ 39' \text{ W}$  changing by  $0^\circ 3' \text{ W}$  per year;  $9^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	036°	096°	216°

	Leg 1	Leg 2	Leg 3
Guy wire directions	004°	124°	244°



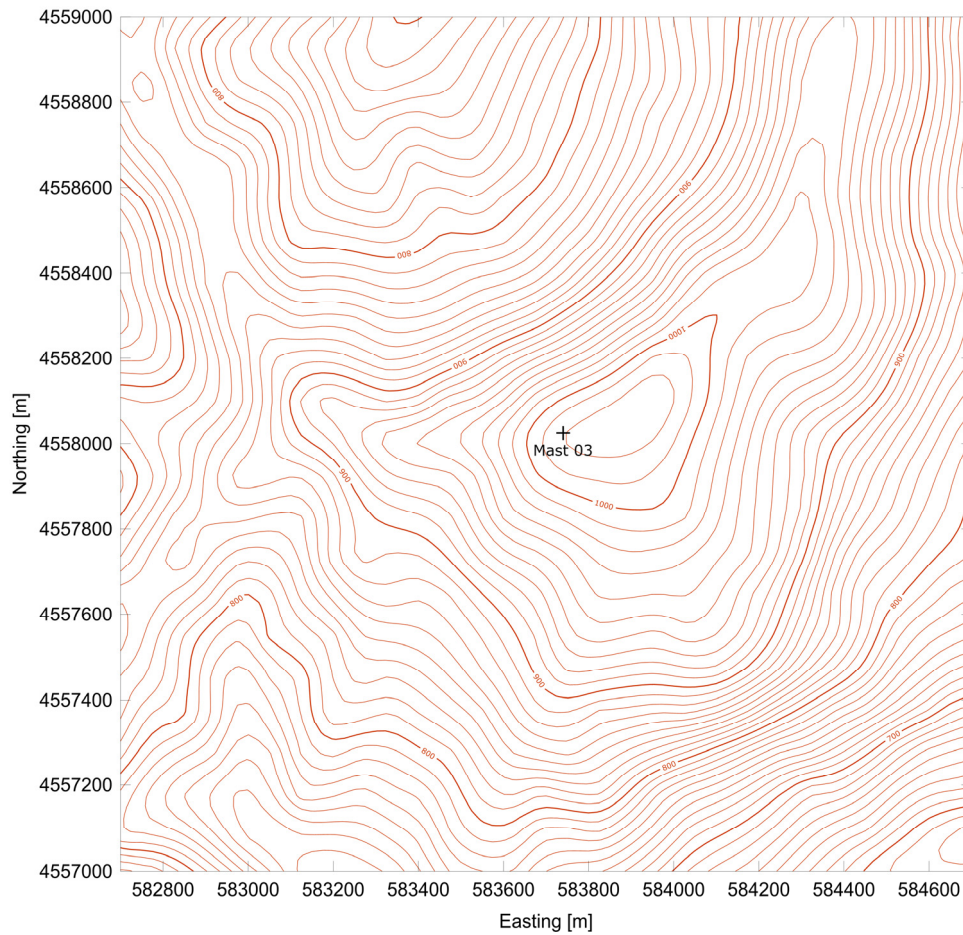


Figure 9. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m height contours.

## 4.2 Observed wind climate

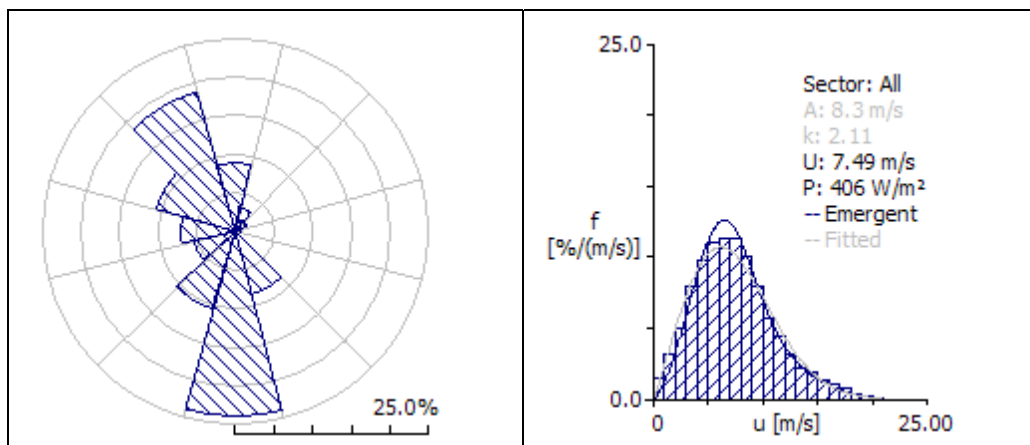


Figure 10. Wind rose and wind speed distribution for Benxi at 70 m a.g.l. The number of observations is 47894 and the recovery rate for 2009 is 91%.



## 5 Fuxin (M10)

M10	121.74360°E	42.31208°N	395 m	E 396457 m	N 4685191 m	UTM 51
-----	-------------	------------	-------	------------	-------------	--------

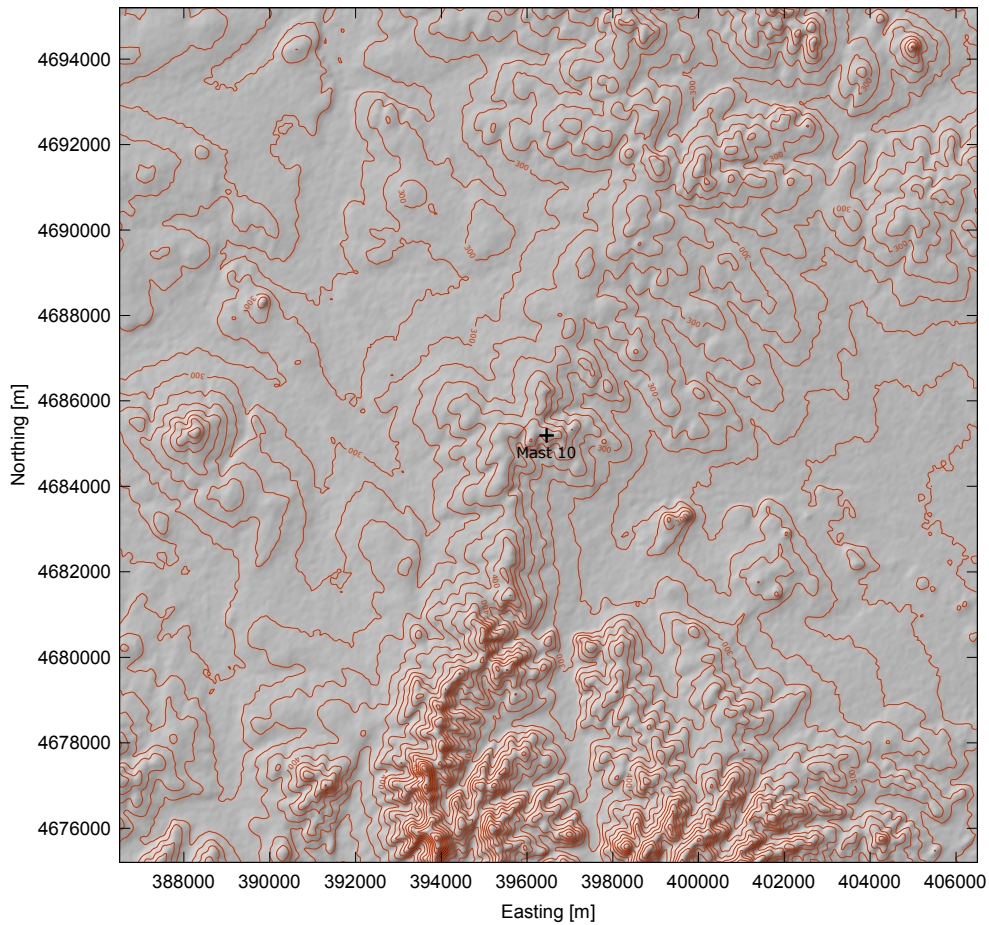


Figure 11. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours.

### 5.1 Site characteristics and observations

The declination is  $8^\circ 32' \text{ W}$  changing by  $0^\circ 4' \text{ W}$  per year;  $9^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	n/a	$356^\circ$	$084^\circ$

	Leg 1	Leg 2	Leg 3
Guy wire directions	$086^\circ$	$209^\circ$	$328^\circ$

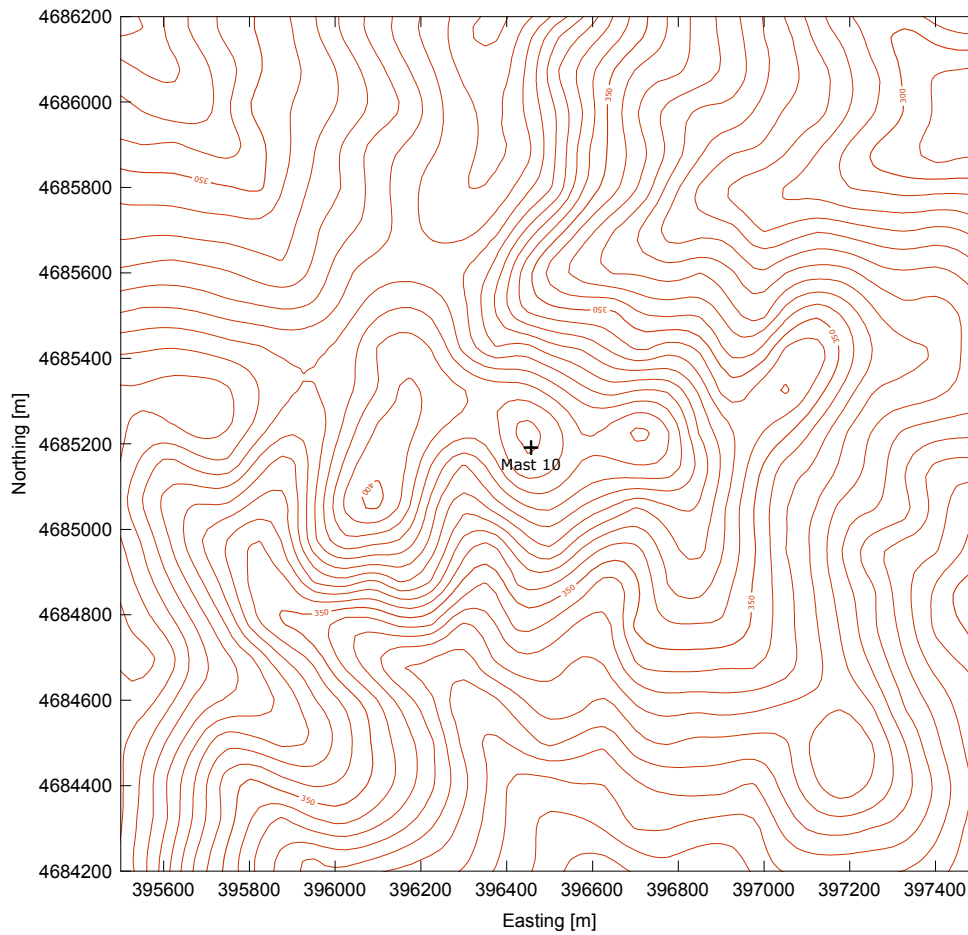


Figure 12. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m contours.

## 5.2 Observed wind climate

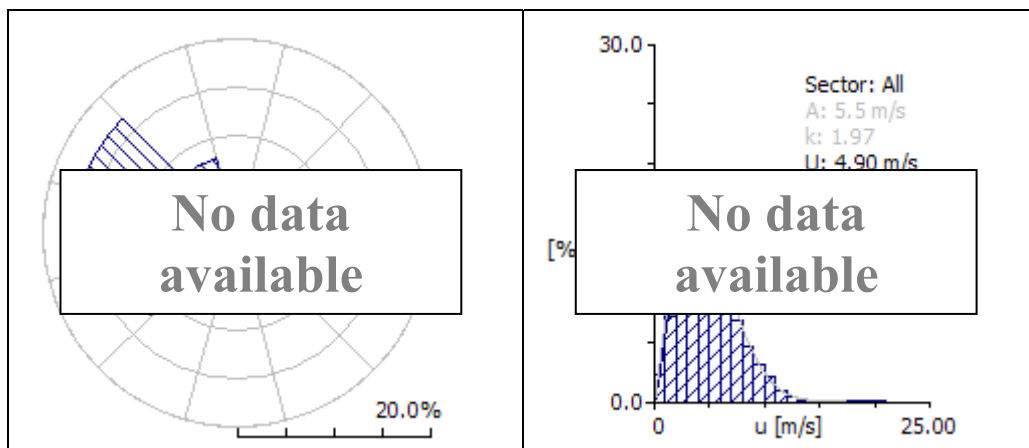


Figure 13. Wind rose and wind speed distribution for Fuxin.

No observed wind climate was available for this station at the time of publication, but this should be added in a future, updated version.



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## 6 Fuxin, Pingandi (ML5)

ML5	121.83645°E	42.46533°N	315 m	E 404342 m	N 4702100 m	UTM 51
-----	-------------	------------	-------	------------	-------------	--------

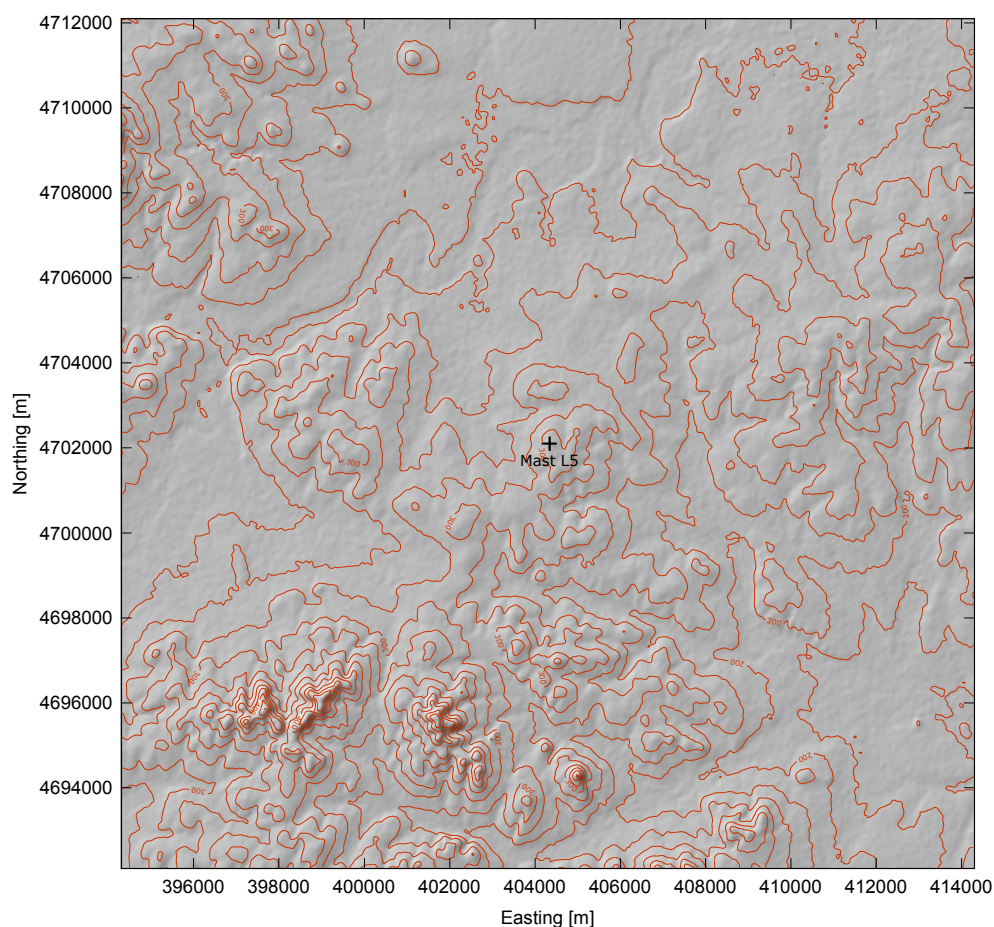


Figure 14. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours. The ruggedness index for the site is 0%.

### 6.1 Site characteristics and observations

The declination is  $8^\circ 36' \text{ W}$  changing by  $0^\circ 4' \text{ W}$  per year;  $9^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	n/a	$341^\circ$	$281^\circ$

	Leg 1	Leg 2	Leg 3
Guy wire directions	$070^\circ$	$191^\circ$	$311^\circ$

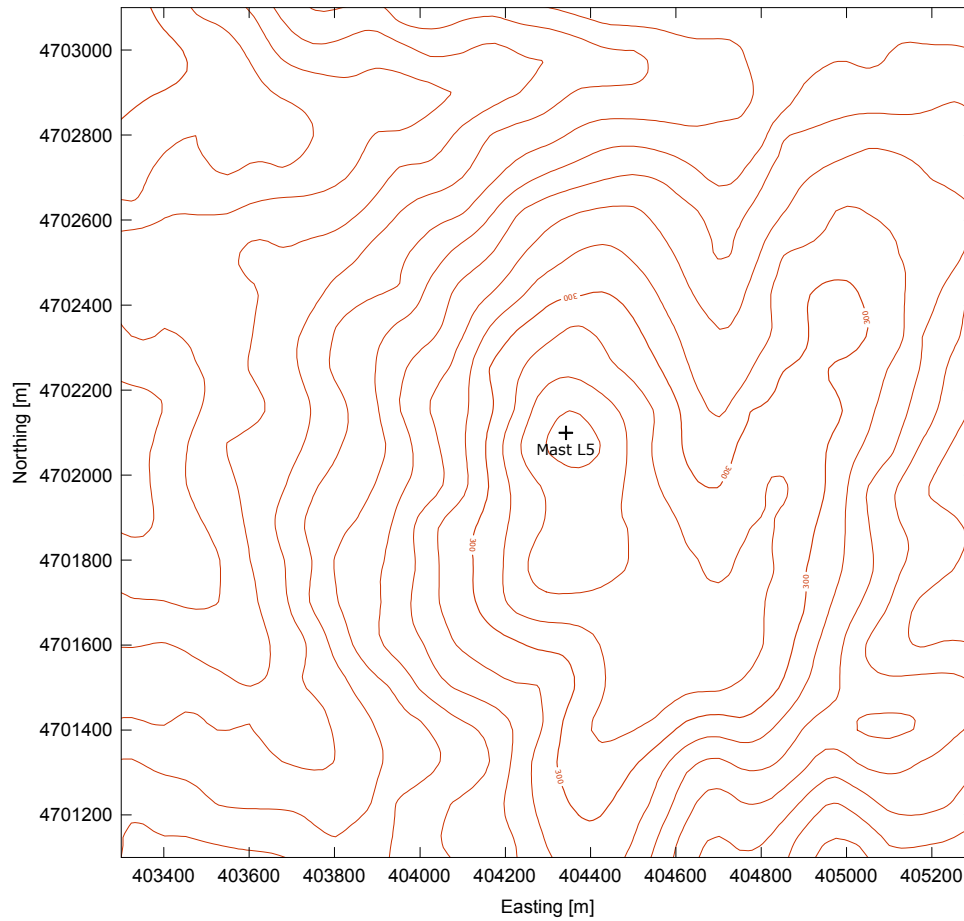


Figure 15. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m contours.

## 6.2 Observed wind climate

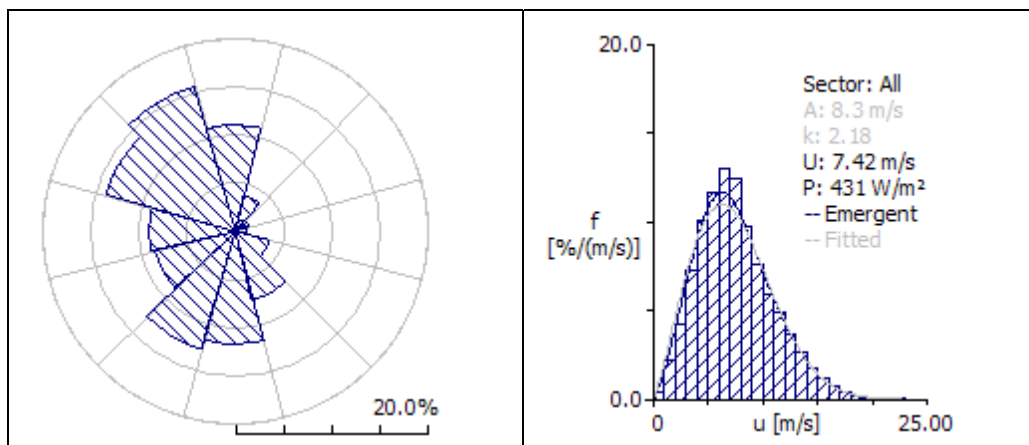


Figure 16. Wind rose and wind speed distribution for Fuxin, Pingandi at 70 m a.g.l. The number of observations is 52560 and the recovery rate is 100%.

## 6.3 Sector photographs

Please note that the sector photographs were not taken with a 30-degree interval.





3



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9



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8



11



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## 7 Jiansheacun, Tongyu, Baicheng (M04)

M04	122.27773°E	44.52714°N	168 m	E 442608 m	N 4930678 m	UTM 51
-----	-------------	------------	-------	------------	-------------	--------

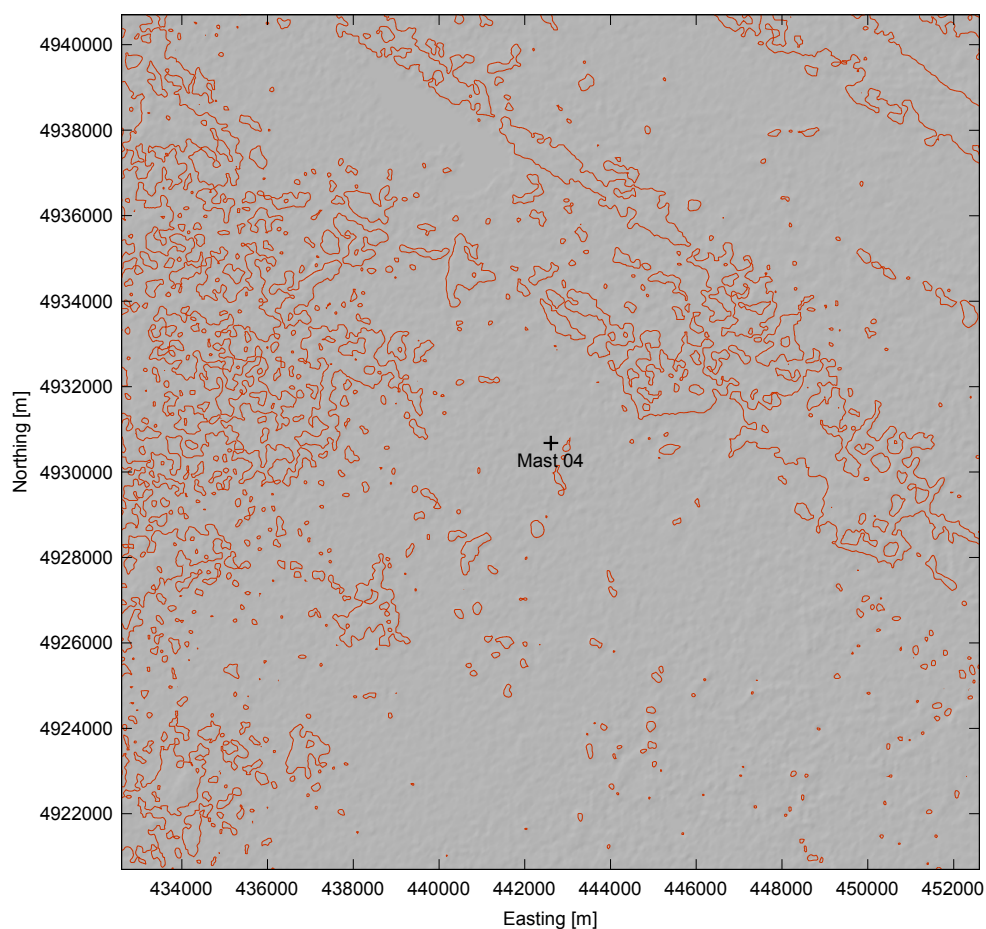


Figure 17. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 10-m contours. The ruggedness index for the site is 0%.

### 7.1 Site characteristics and observations

The declination is  $9^\circ 16' \text{ W}$  changing by  $0^\circ 4' \text{ W}$  per year;  $9^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	$163^\circ$	$223^\circ$	$284^\circ$

	Leg 1	Leg 2	Leg 3
Guy wire directions	n/a	n/a	n/a

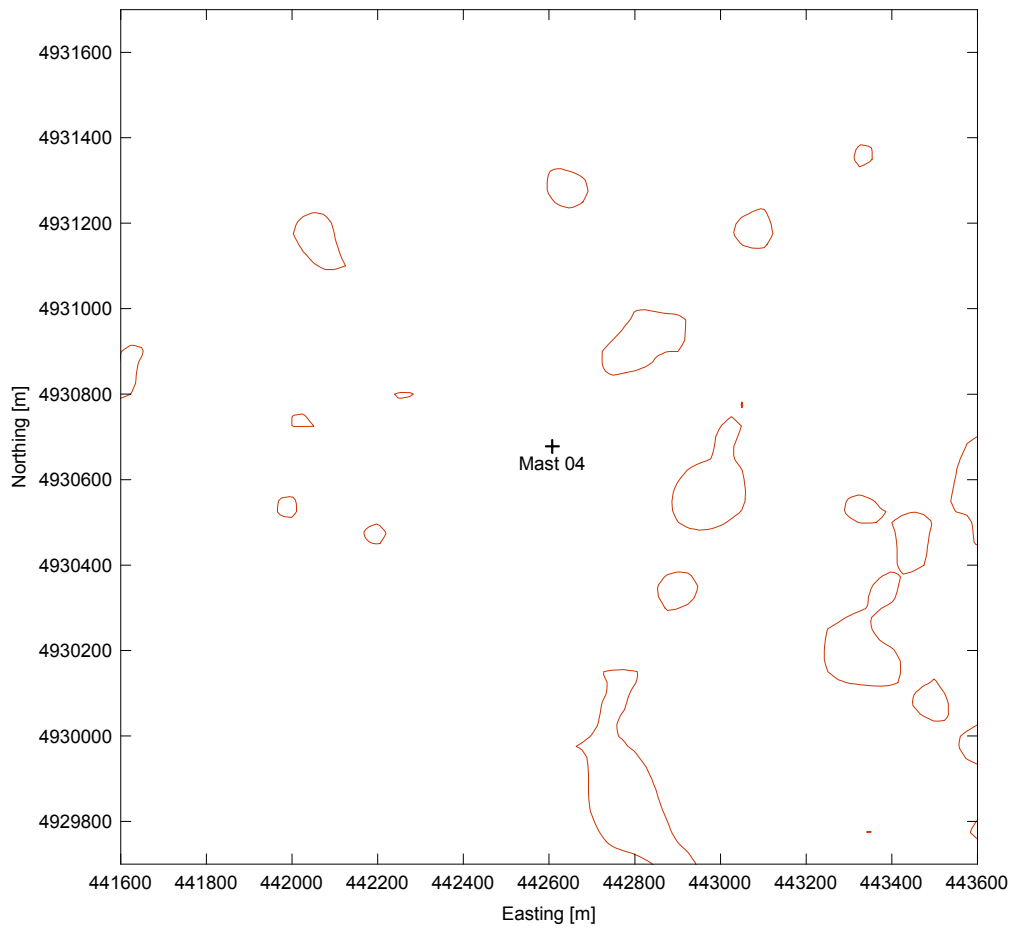


Figure 18. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m contours.

## 7.2 Observed wind climate

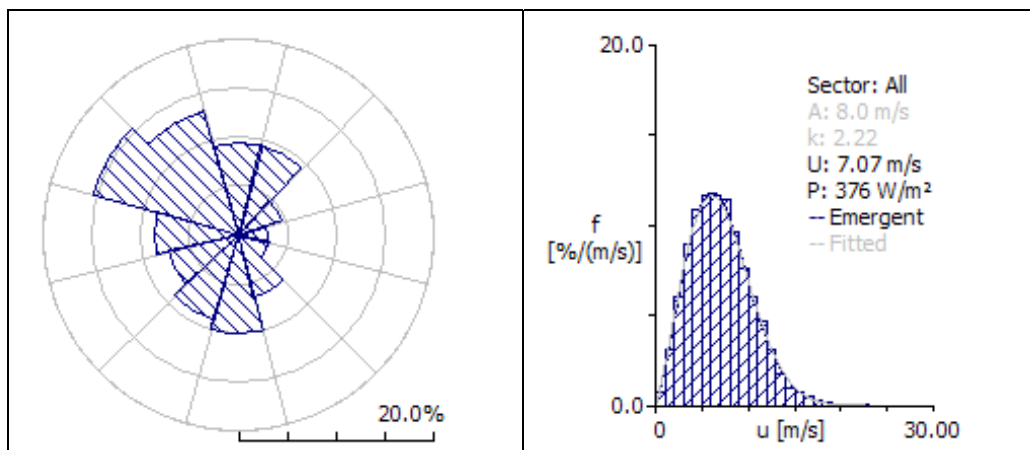


Figure 19. Wind rose and wind speed distribution for Jianshecun at 70 m a.g.l. The number of observations is 52560 and the recovery rate is 100%.



060



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## 8 Chuizi, Qian'an, Songyuan (M05)

M05	123.65746°E	44.94102°N	136 m	E 551871 m	N 4976609 m	UTM 51
-----	-------------	------------	-------	------------	-------------	--------

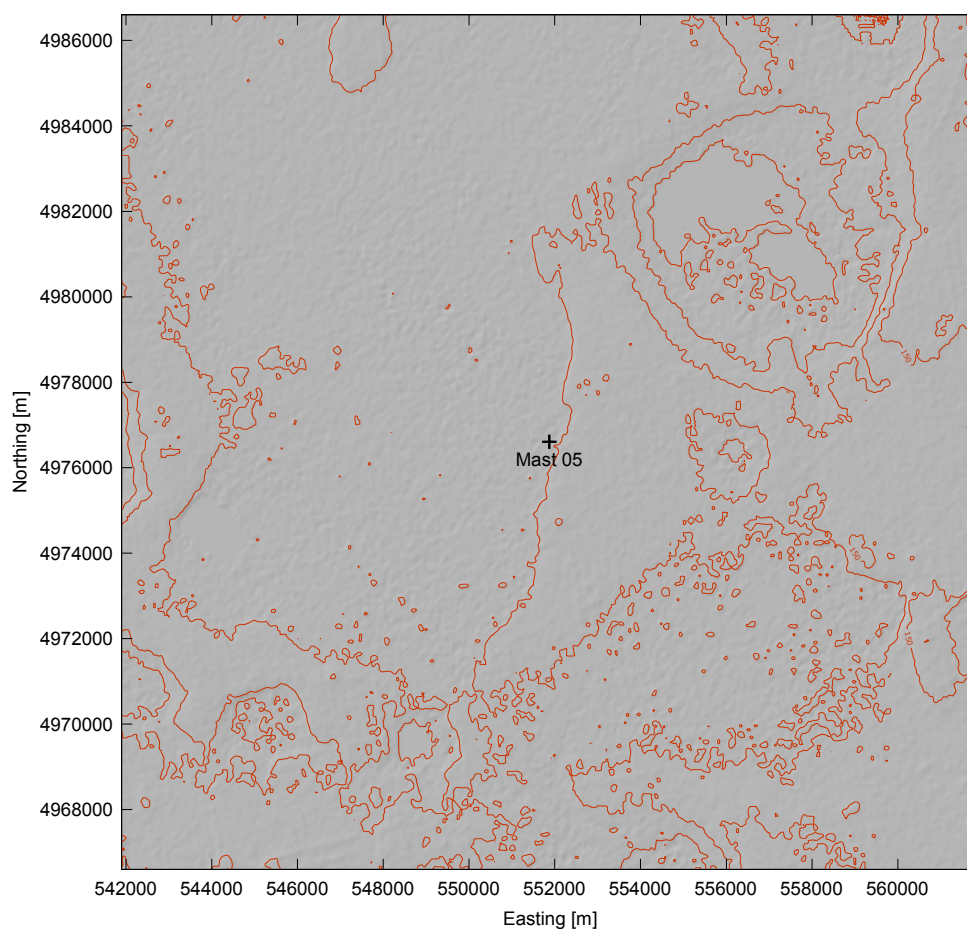


Figure 20. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 10-m contours. The ruggedness index for the site is 0%.

### 8.1 Site characteristics and observations

The declination is  $9^\circ 40' \text{ W}$  changing by  $0^\circ 3' \text{ W}$  per year;  $10^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	$168^\circ$	$107^\circ$	$288^\circ$

	Leg 1	Leg 2	Leg 3
Guy wire directions	n/a	n/a	n/a

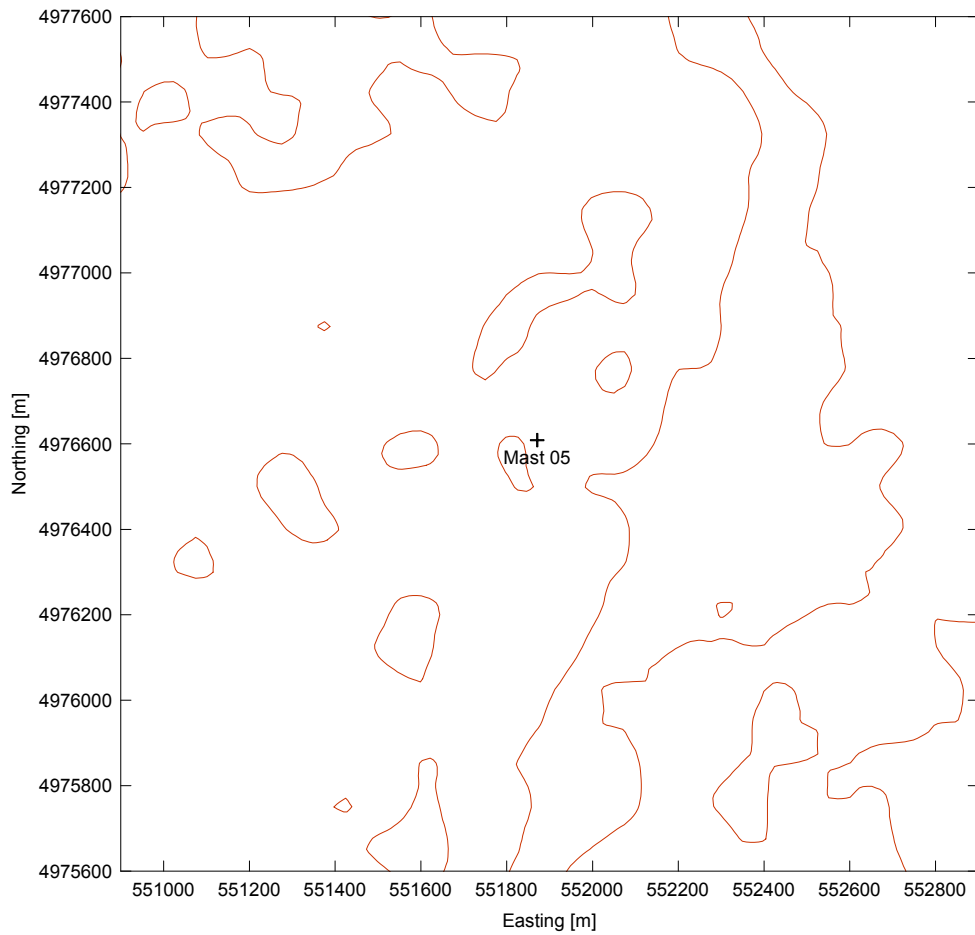


Figure 21. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m contours.

## 8.2 Observed wind climate

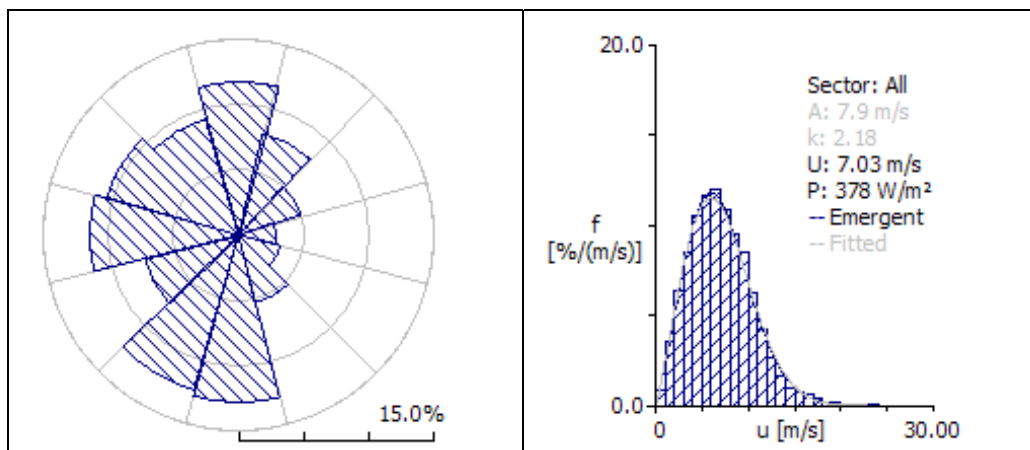


Figure 22. Wind rose and wind speed distribution for Chuizi at 70 m a.g.l. The number of observations is 52560 and the recovery rate is 100%.





060



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330



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300



180



270



## 9 Tuanshan,Bolichengzi, Gongzhuling, Siping (M06)

M06	124.10508°E	43.94166°N	185 m	E 588686 m	N 4865987 m	UTM 51
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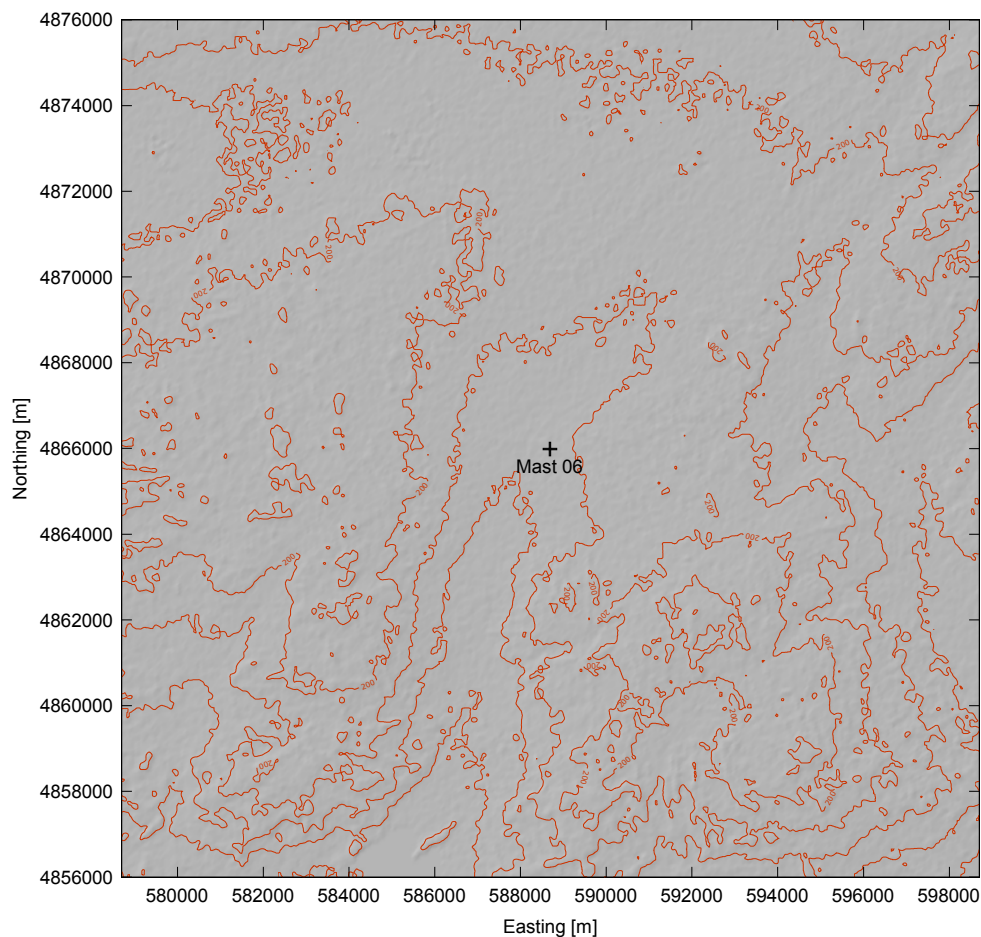


Figure 23. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 10-m contours. The ruggedness index for the site is 0%.

### 9.1 Site characteristics and observations

The declination is  $9^\circ 28'$  W changing by  $0^\circ 3'$  W per year;  $9^\circ$  W is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	$316^\circ$	$255^\circ$	$136^\circ$

	Leg 1	Leg 2	Leg 3
Guy wire directions	n/a	n/a	n/a

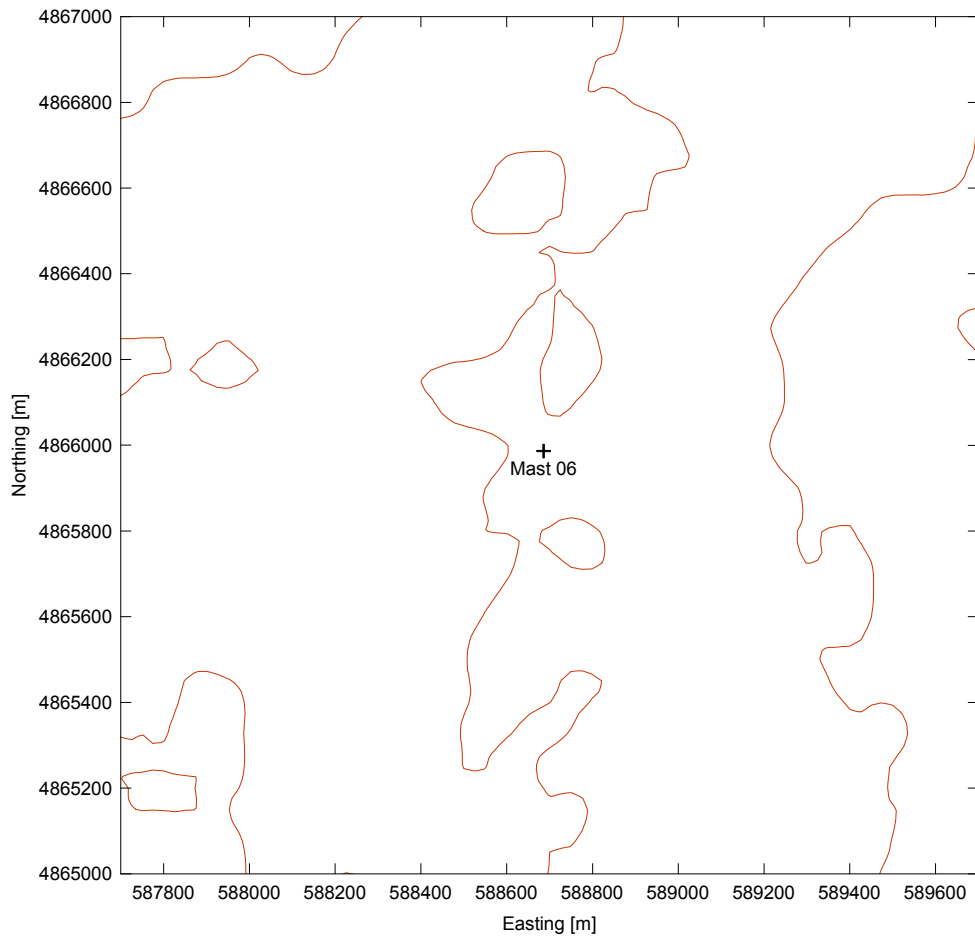


Figure 24. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m contours.

## 9.2 Observed wind climate

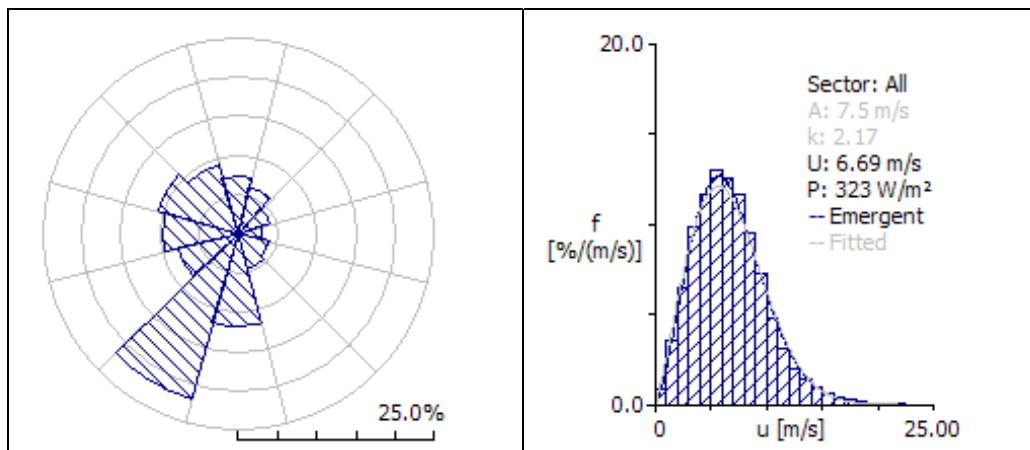


Figure 25. Wind rose and wind speed distribution for Tuanshan at 70 m a.g.l. The number of observations is 52560 and the recovery rate is 100%. Data from Risø DTU measurements (Jul-Dec 2009) and CMA measurements (Jan-Jun 2009).



060



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030



120



000



090





240



330



210



300



180



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## 10 Jingxincun, Hunchun, Yanbian (M11)

M11	130.53070°E	42.60573°N	15 m	E 625561 m	N 4718169 m	UTM 52
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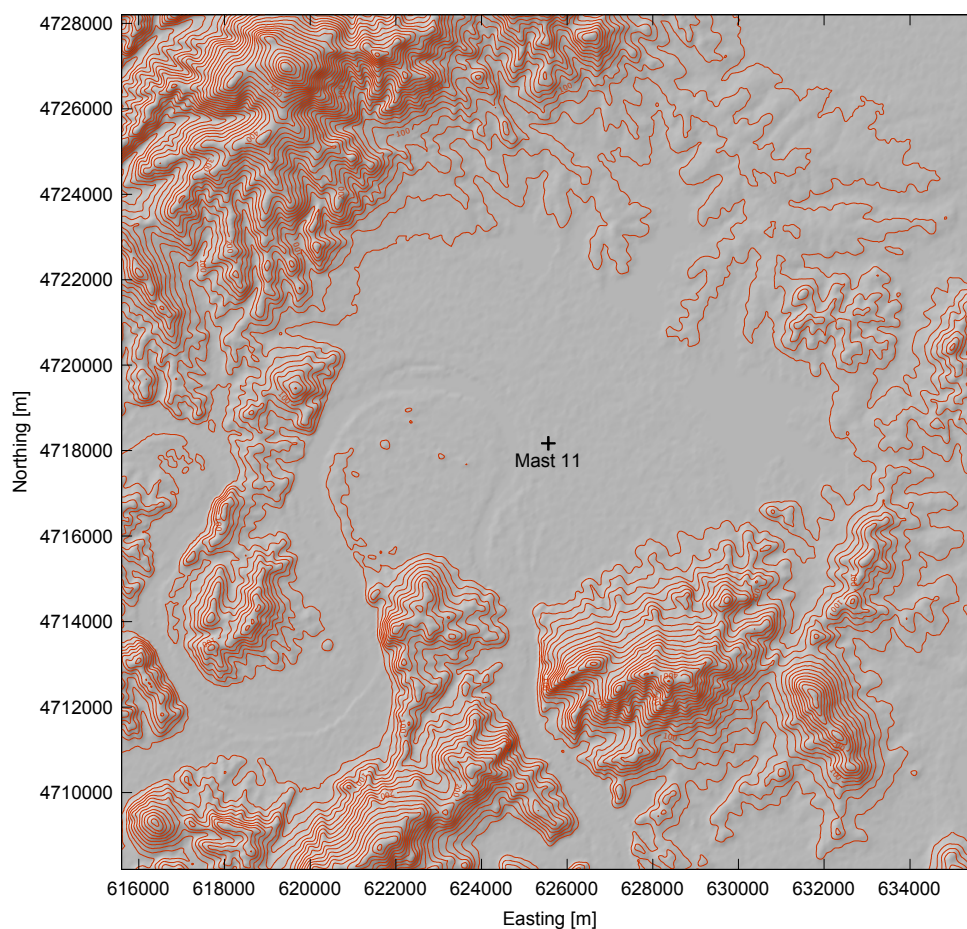


Figure 26. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours.

### 10.1 Site characteristics and observations

The declination is  $9^\circ 46' \text{ W}$  changing by  $0^\circ 1' \text{ W}$  per year;  $10^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	n/a	$340^\circ$	$070^\circ$

	Leg 1	Leg 2	Leg 3
Guy wire directions	$070^\circ$	$195^\circ$	$310^\circ$



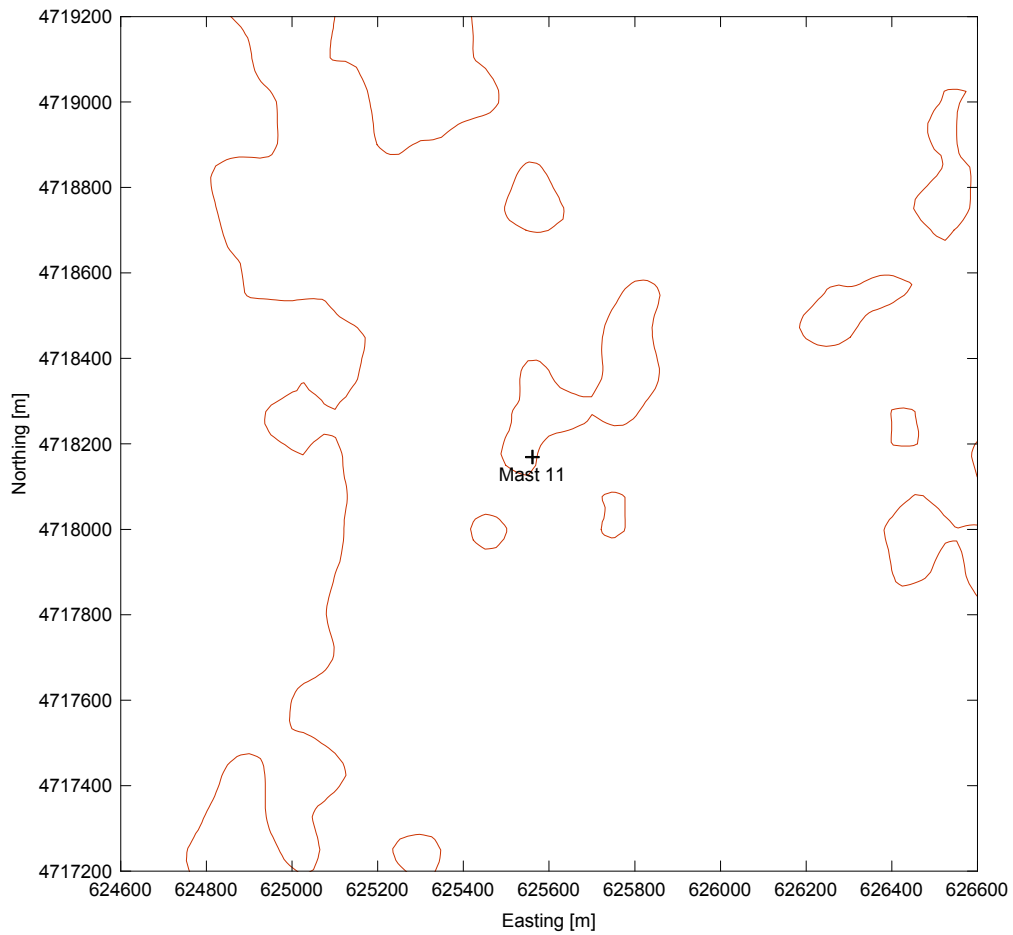


Figure 27. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m contours.

## 10.2 Observed wind climate

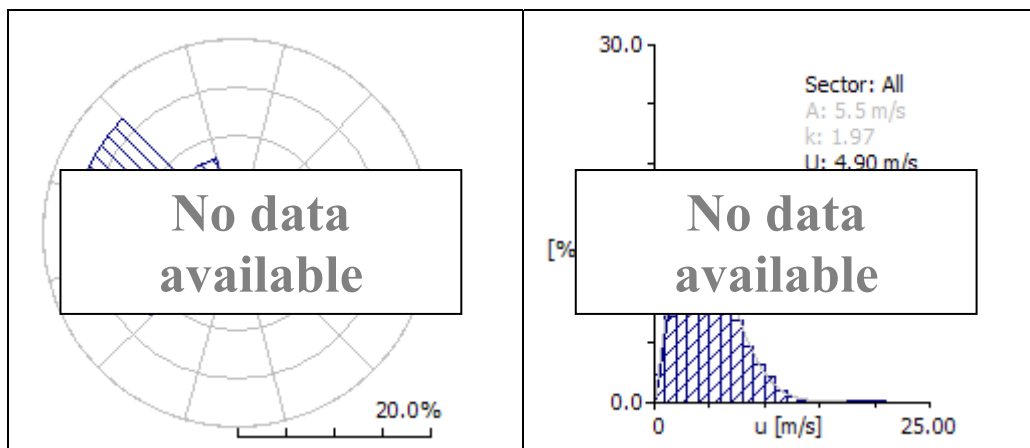


Figure 28. Wind rose and wind speed distribution for Jingxincun.

No observed wind climate was available for this station at the time of publication, but this should be added in a future, updated version.



3



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4





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7



11



10



# 11 Songyuan, Qlanguo, Chaganhuacun (MJ5)

MJ5	124.01715°E	44.61596°N	155 m	E 580701 m	N 4940793 m	UTM 51
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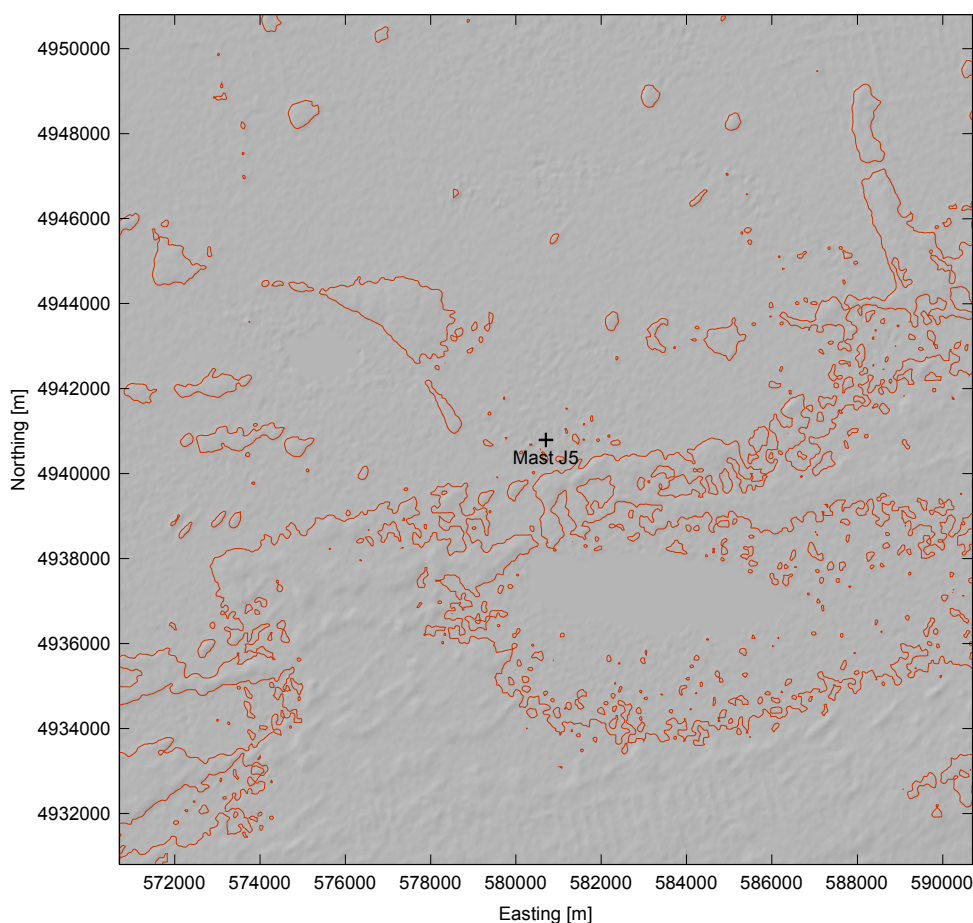


Figure 29. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours. The ruggedness index for the site is 0%.

## 11.1 Site characteristics and observations

The declination is  $9^\circ 39' \text{ W}$  changing by  $0^\circ 3' \text{ W}$  per year;  $10^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	n/a	$145^\circ$	n/a

	Leg 1	Leg 2	Leg 3
Guy wire directions	$056^\circ$	$176^\circ$	$296^\circ$

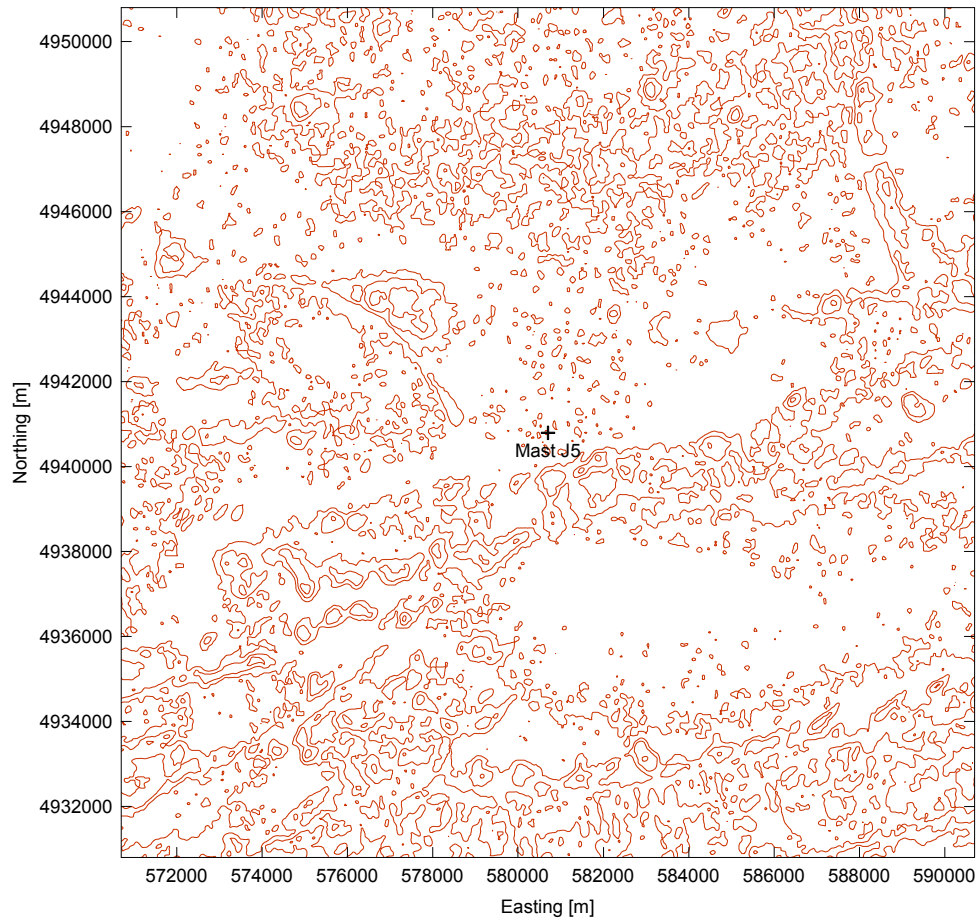


Figure 30. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m contours.

## 11.2 Observed wind climate

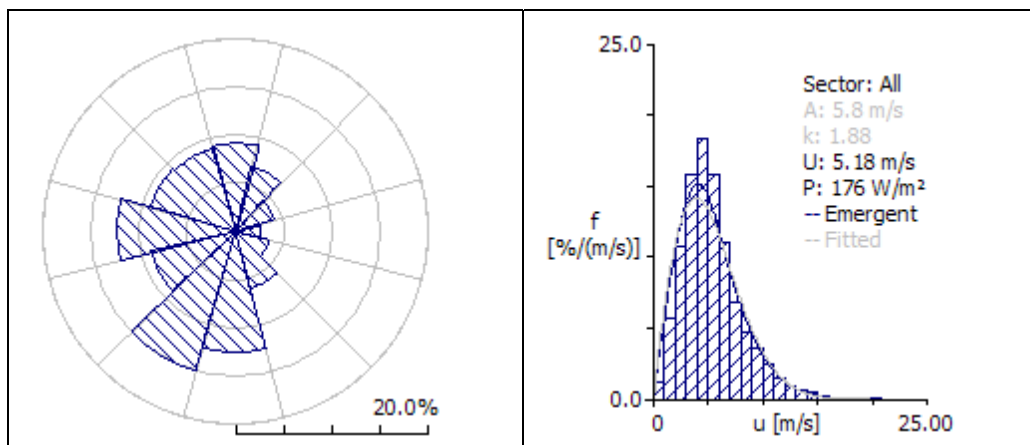


Figure 31. Wind rose and wind speed distribution for Songyuan at 30 m a.g.l. The number of observations is 52560 and the recovery rate is 100%.



060



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030



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240



330



210



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270

## 12 Tongjiang, Bachaxiang (M07)

M07	133.87547°E	48.21450°N	40 m	E 416464 m	N 5340753 m	UTM 53
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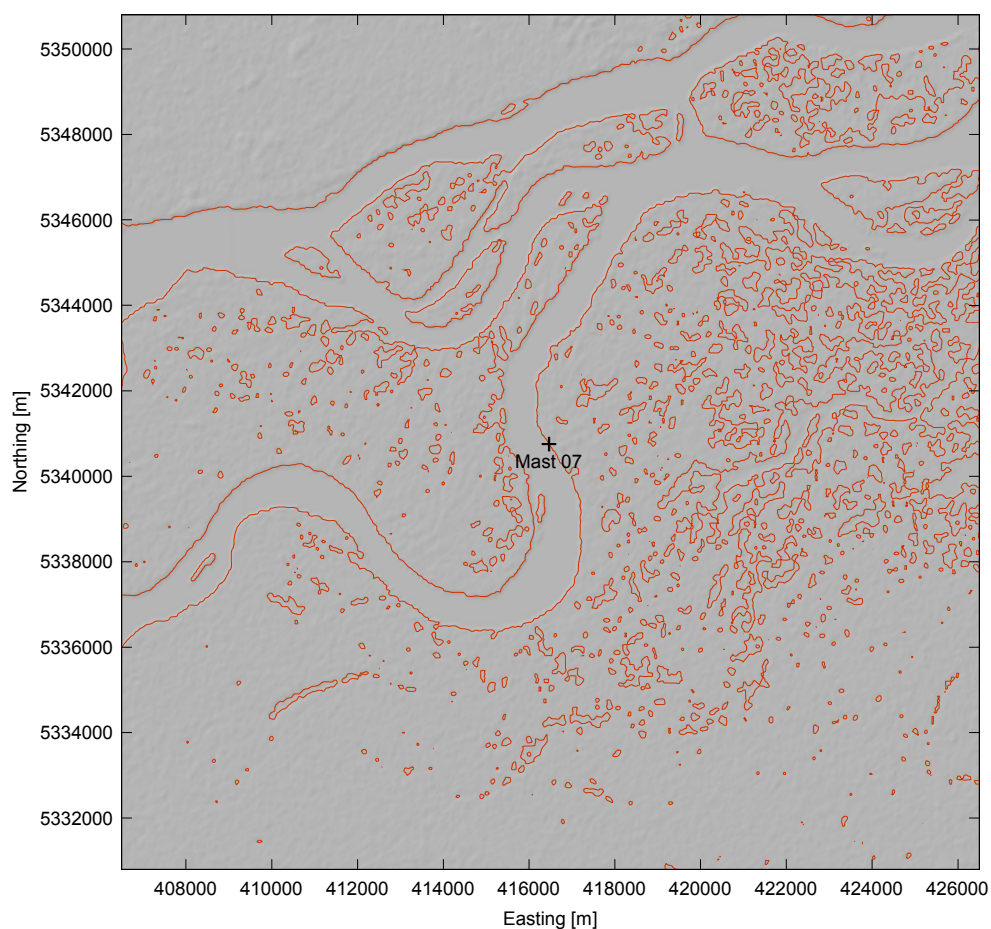


Figure 32. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours. The ruggedness index for the site is 0%.

### 12.1 Site characteristics and observations

The declination is  $11^\circ 34' \text{ W}$  changing by  $0^\circ 0' \text{ E}$  per year;  $12^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions			

	Leg 1	Leg 2	Leg 3
Guy wire directions			

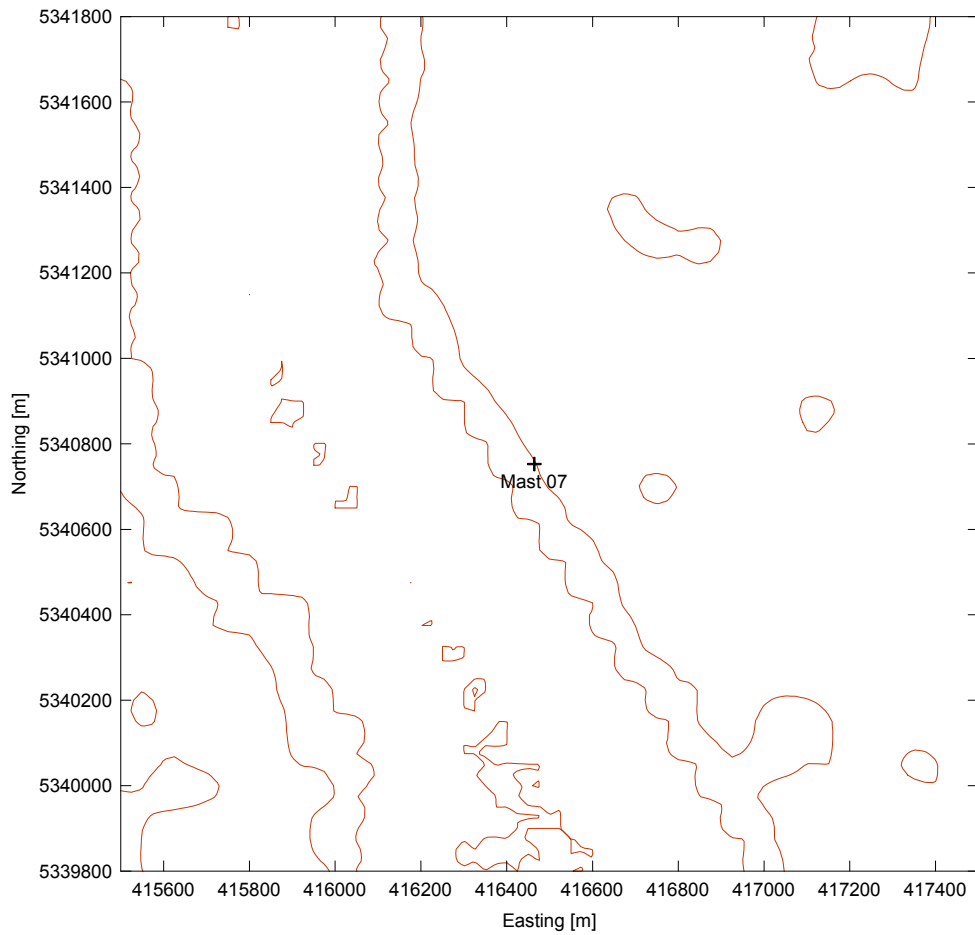


Figure 33. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m contours.

## 12.2 Observed wind climate

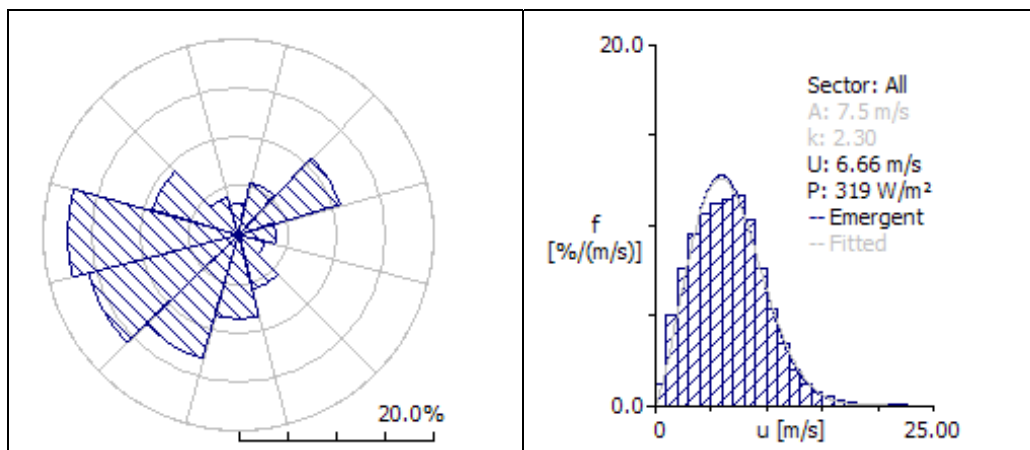


Figure 34. Wind rose and wind speed distribution for Tongjiang at 70 m a.g.l. The number of observations is 52560 and the recovery rate is 100%.



## 13 Suiling, Koumenzi (M08)

M08	127.64503°E	47.66755°N	327 m	E 398278 m	N 5280240 m	UTM 52
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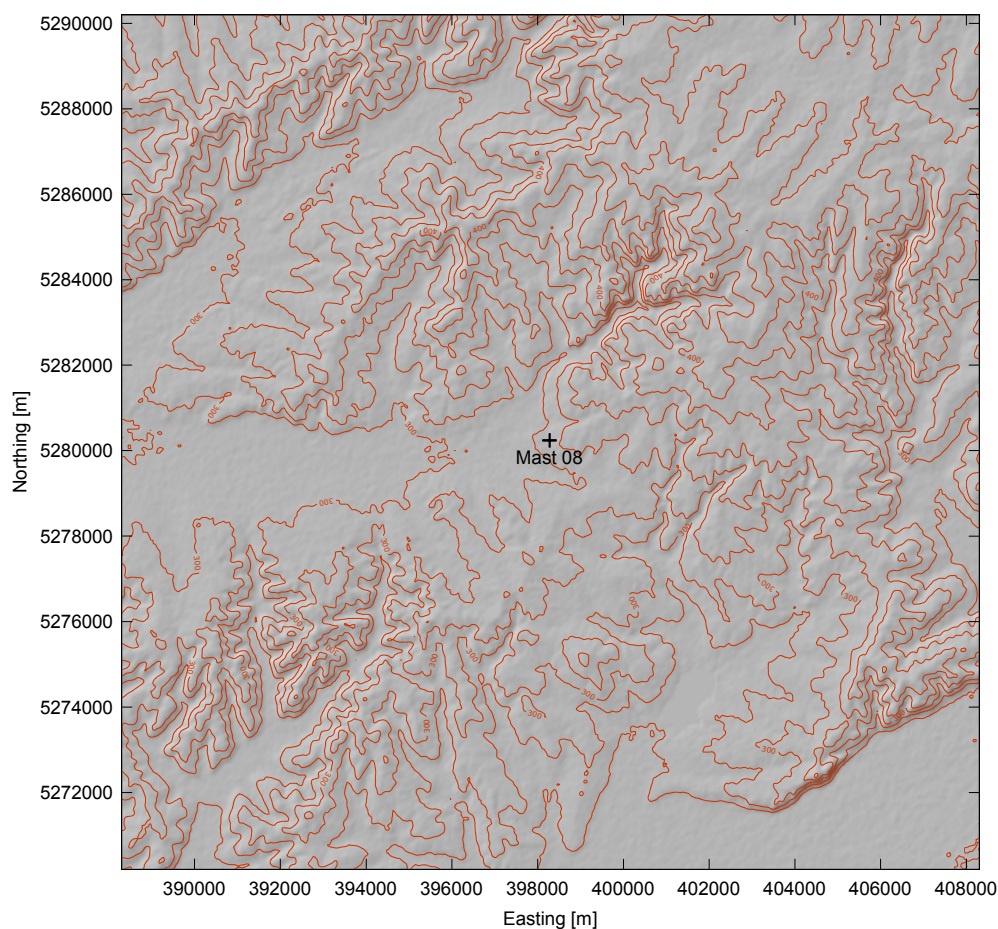


Figure 35. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours. The ruggedness index for the site is 0%.

### 13.1 Site characteristics and observations

The declination is  $11^\circ 7' \text{ W}$  changing by  $0^\circ 1' \text{ W}$  per year;  $11^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	209°	149°	329°

	Leg 1	Leg 2	Leg 3
Guy wire directions	n/a	n/a	n/a

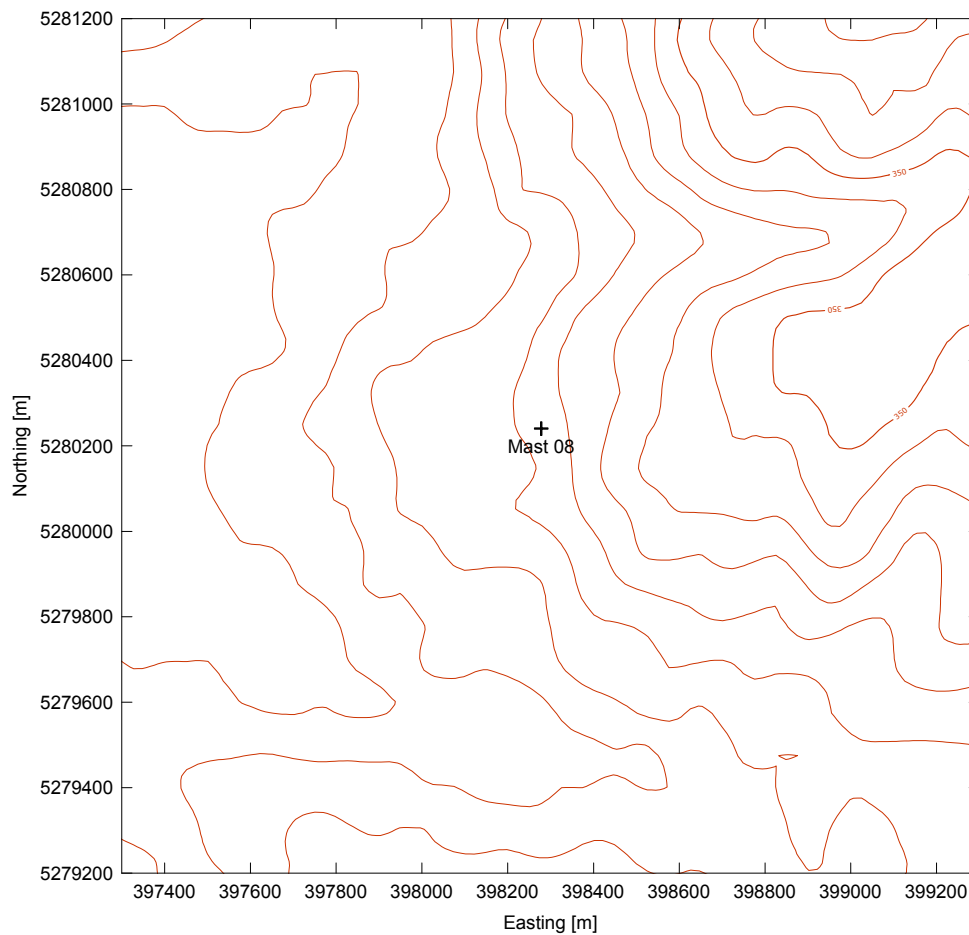


Figure 36. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m contours.

## 13.2 Observed wind climate

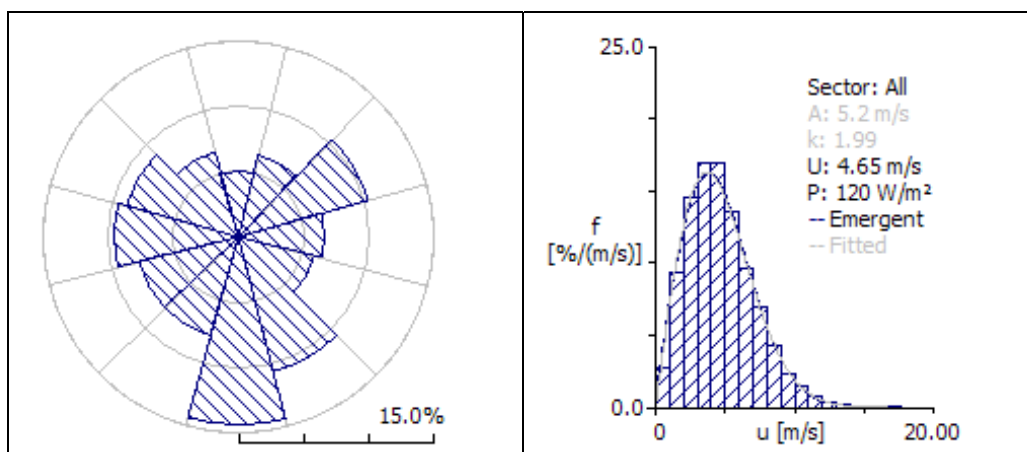


Figure 37. Wind rose and wind speed distribution for Suiling at 70 m a.g.l. The number of observations is 52560 and the recovery rate is 100%.

## 14 Zhaozhou, Tianzhutang (M09)

M09	125.34413°E	45.74241°N	147 m	E 215611 m	N 5071930 m	UTM 52
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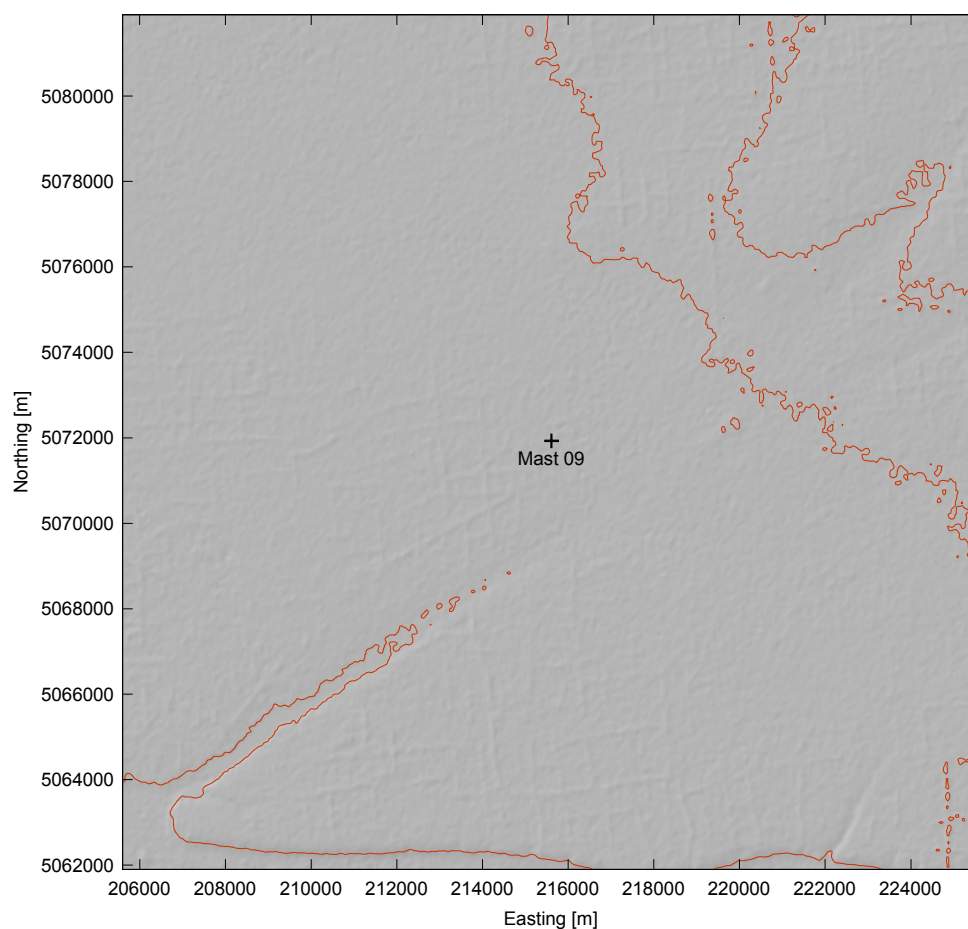


Figure 38. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours. The ruggedness index for the site is 0%.

### 14.1 Site characteristics and observations

The declination is  $10^\circ 13' \text{ W}$  changing by  $0^\circ 2' \text{ W}$  per year;  $10^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	$235^\circ$	$294^\circ$	$114^\circ$

	Leg 1	Leg 2	Leg 3
Guy wire directions	n/a	n/a	n/a



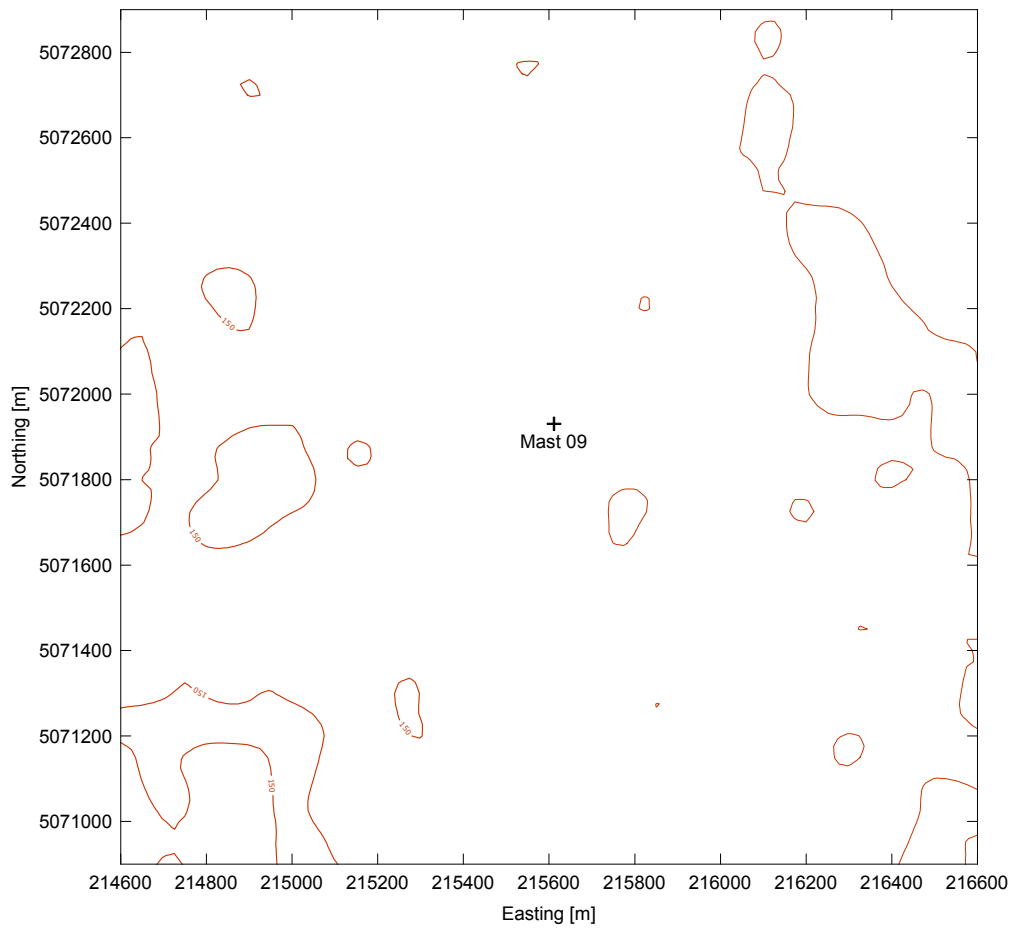


Figure 39. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m contours.

## 14.2 Observed wind climate

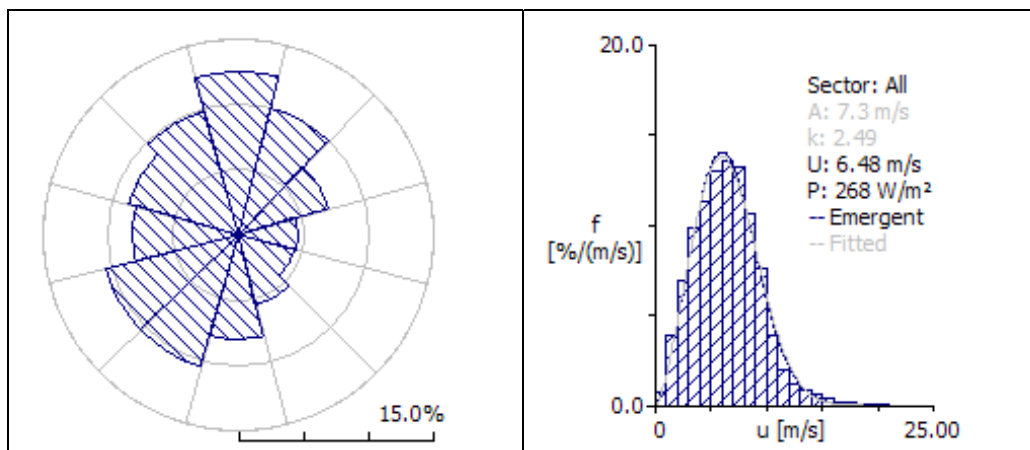


Figure 40. Wind rose and wind speed distribution for Zhaozhou at 70 m a.g.l. The number of observations is 52560 and the recovery rate is 100%.



060



150



030



120



000



090





240



210



180



330



300



270



## 15 Yilan, 100-m mast (M12)

M12	129.57772°E	46.30003°N	95 m	E 544492 m	N 5127546 m	UTM 52
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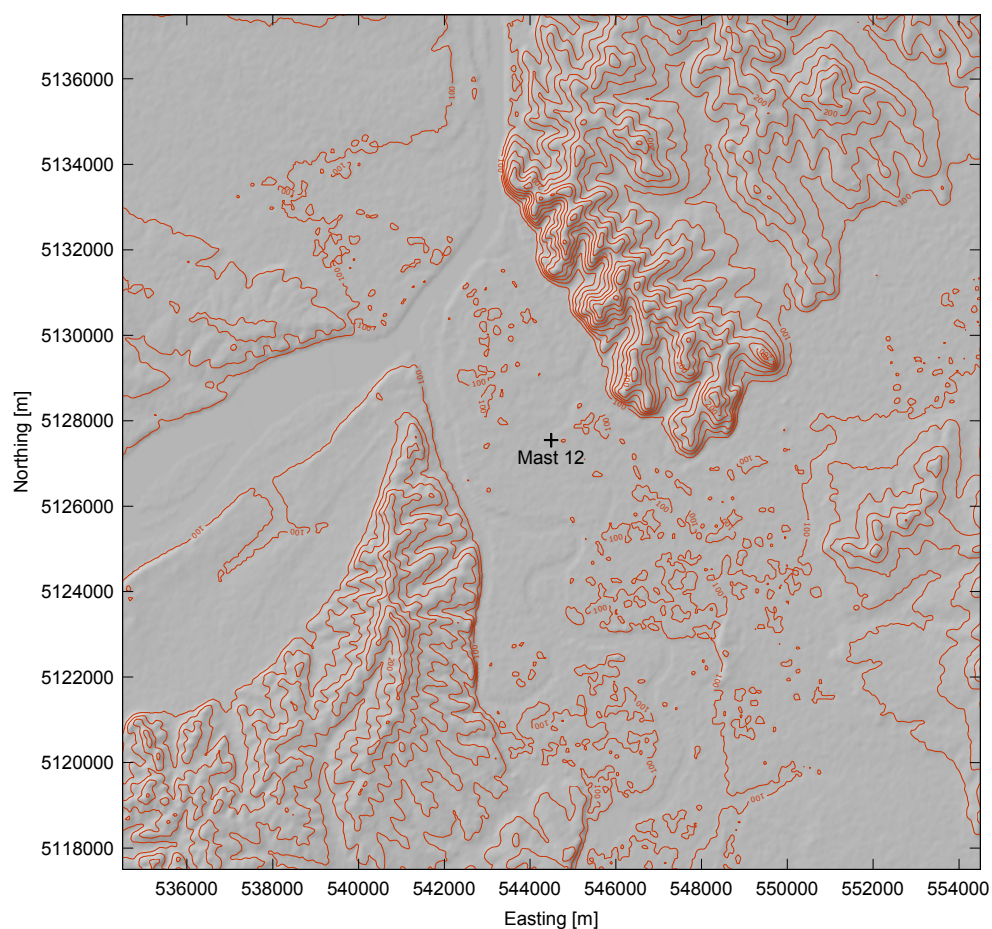


Figure 41. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours.

### 15.1 Site characteristics and observations

The declination is  $10^\circ 53' \text{ W}$  changing by  $0^\circ 1' \text{ W}$  per year;  $11^\circ \text{ W}$  is used to convert from magnetic to true directions/bearings. Boom and guy wire (true) directions are given in the tables below.

	Risø cup and vane	CMA cup	CMA vane
Boom directions	n/a	$229^\circ$	$229^\circ$

	Leg 1	Leg 2	Leg 3
Guy wire directions	n/a	n/a	n/a

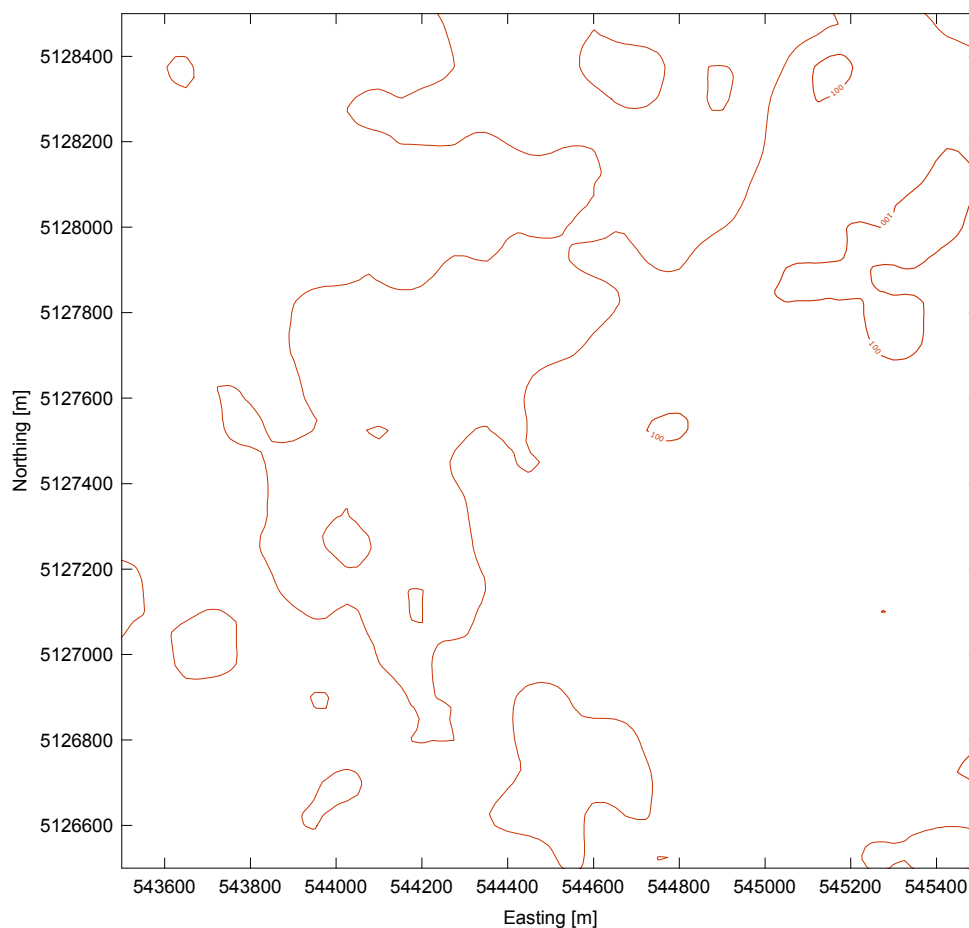


Figure 42. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m height contours.

## 15.2 Observed wind climate

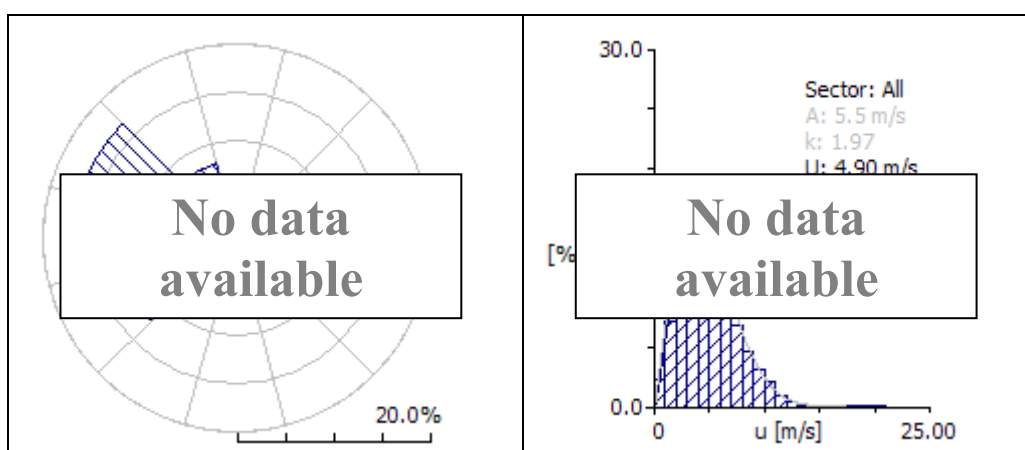


Figure 43. Wind rose and wind speed distribution for Yilan.

No observed wind climate was available for this station at the time of publication, but this should be added in a future, updated version.



060



150



030



120



000



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240



330



210



300



180



270

## 16 Jiamusi Tuanjiexishan (MH5)

MH5	130.33285°E	46.64002°N	312 m	E 602009 m	N 5166025 m	UTM 52
-----	-------------	------------	-------	------------	-------------	--------

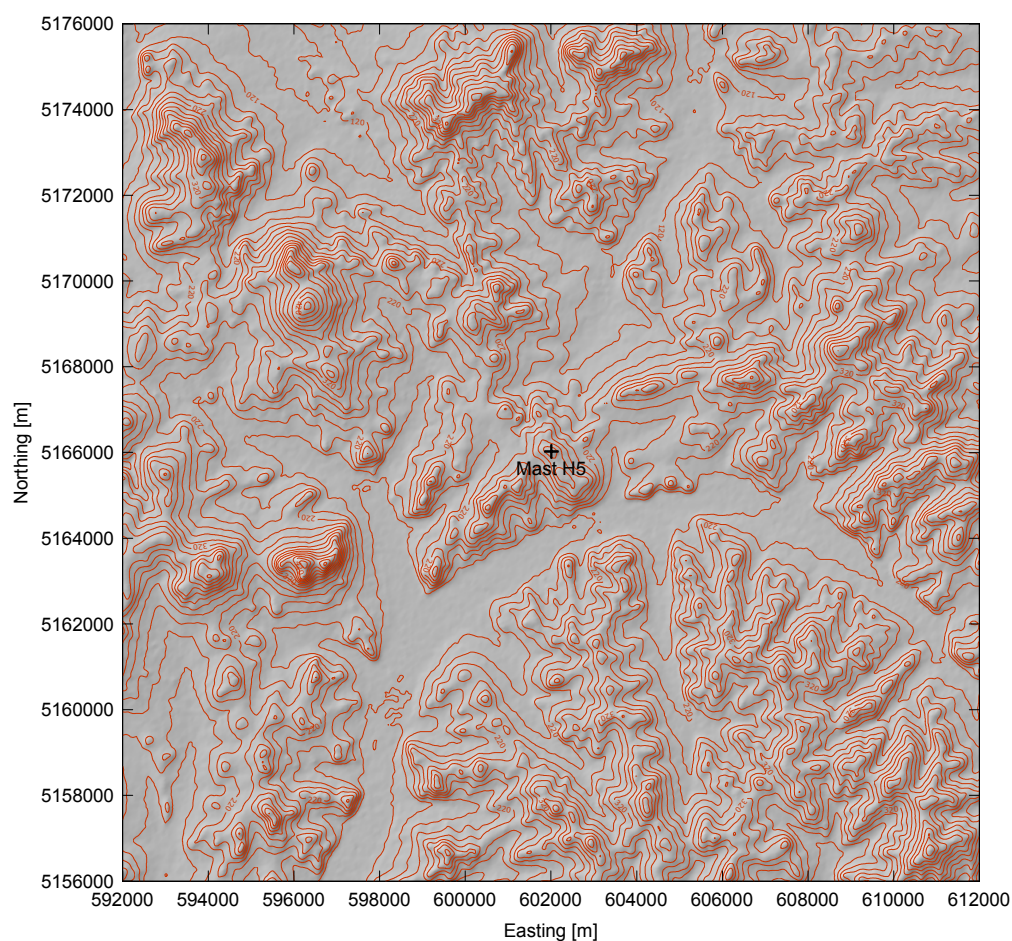


Figure 44. Elevation map from SRTM3 data, covering  $20 \times 20 \text{ km}^2$ , with 20-m contours. The ruggedness index for the site is 0.2%.

### 16.1 Site characteristics and observations

This site and mast has not been visited by Risø DTU and the position has not been verified.

The declination is  $11^\circ 2' \text{ W}$ , changing by  $0^\circ 1' \text{ W/year}$ .



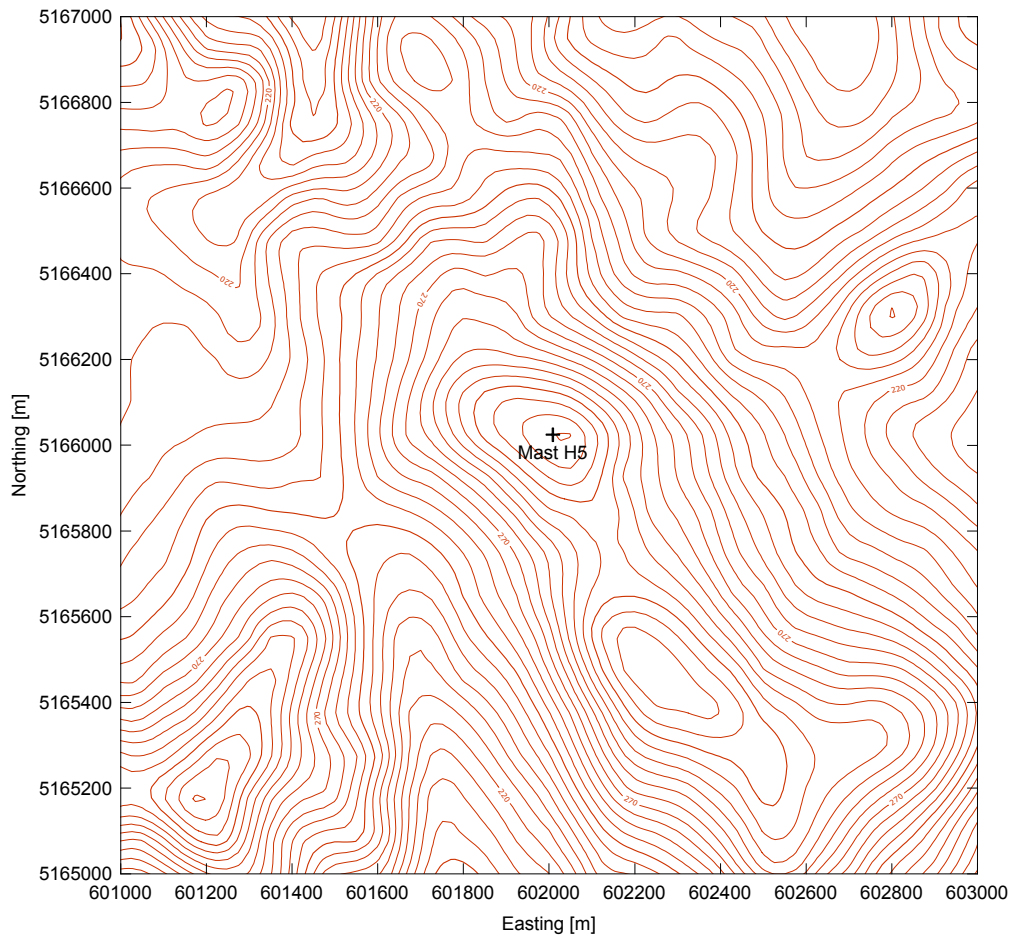


Figure 45. Elevation map from SRTM3 data, covering  $2 \times 2 \text{ km}^2$ , with 5-m height contours.

## 16.2 Observed wind climate

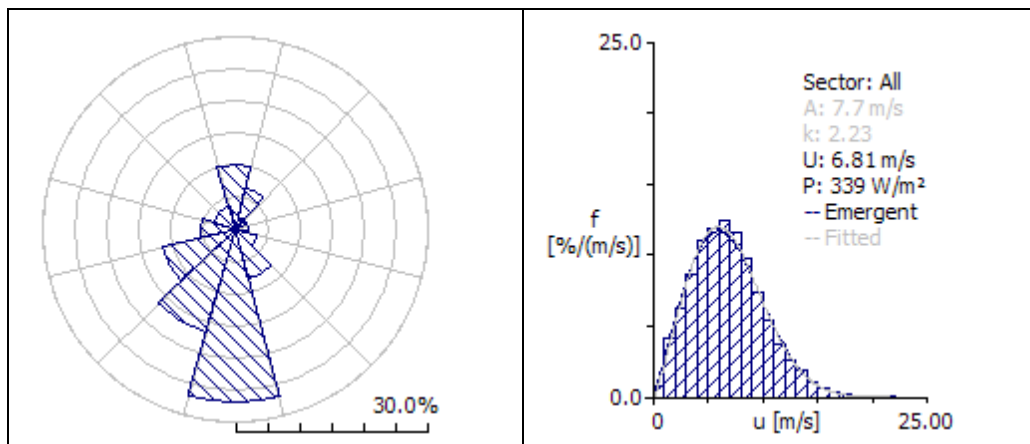


Figure 46. Wind rose and wind speed distribution for Jiamusi at 70 m a.g.l. Data period for mast MH5 is from 2008-11-01 to 2009-11-01. The number of observations is 52560 and the recovery rate is 100%.



## 17 Acknowledgements

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## 18 References

Mortensen, N.G., D.N. Heathfield, O. Rathmann and Morten Nielsen (2009). *Wind Atlas Analysis and Application Program: WAsP 10 Help Facility*. Risø National Laboratory for Sustainable Energy, Technical University of Denmark, Roskilde, Denmark. 356 topics.

Mortensen, N.G., Z. Yang, J.C. Hansen, O. Rathmann and M. Kelly (2010). Meso- and Micro-scale Modelling in China: Wind atlas analysis for 12 meteorological stations in NE China (Dongbei). Risø-I-3072(EN). ? pp.

## Appendix – Availability of wind measurements

Figure 47 shows the status of the meteorological measurements conducted with Risø DTU equipment at the time of writing.

CMA Component of WED: Status of Risø DTU measurements and data by 2010-06-15.

Station	Installed	Position	Data start	Data end	Raw data	CA project	Team site	In operation	Risø Rodeo	CMA
<b>Liaoning</b>							availability	% of 2009	database	database
Mast 01	Yes	Verified	2008-10-07	2010-01-31	Team site	Revision 1	481 d	100%	Yes	
Mast 02	Yes	Verified	2008-08-29	2010-02-10	Team site	Revision 1	541 d	100%	Yes	
Mast 03	Yes	Verified	2008-09-25	2010-01-31	Team site	Revision 1	491 d	100%	Yes	
Mast 10	No	Verified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mast L5	n/a	Verified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
<b>Jilin</b>										
Mast 04	Yes	Verified	2008-10-14	2010-03-24	Team site	Revision 1	526 d	100%	Yes	
Mast 05	Yes	Verified	2008-10-15	2010-03-25	Team site	Revision 1	526 d	100%	Yes	
Mast 06	Yes	Verified	2009-06-10	2010-03-26	Team site	Revision 1	289 d	56%	Yes	
Mast 11	No	Verified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mast J5	n/a	Verified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
<b>Heilongjiang</b>										
Mast 07	Yes	Verified	2008-09-04	2010-01-31	Team site	Revision 1	515 d	100%	Yes	
Mast 08	Yes	Verified	2008-10-12	2010-01-31	Team site	Revision 1	476 d	100%	Yes	
Mast 09	Yes	Verified	2008-10-10	2010-01-31	Team site	Revision 1	479 d	100%	Yes	
Mast 12	No	Verified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mast H5	n/a	Preliminary	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total								95%		

Figure 47. Status of Risø DTU measurements as of 15 June 2010. The “% of 2009” column shows the potential availability of data rather than the actual data recovery rate.

Figure 48 shows the status of the meteorological measurements conducted with CMA equipment at the time of writing.

CMA Component of WED: Status of CMA measurements and data by 2010-06-15.

Station	Installed	Position	Data start	Data end	Raw data	CA project	Team site	In operation	Risø Rodeo	CMA
<b>Liaoning</b>							availability	% of 2009	database	database
Mast 01	Yes	Verified					0 d	0%		
Mast 02	Yes	Verified	2008-10-16	2009-11-10	Team site	Revision 1	390 d	63%	In progress	
Mast 03	Yes	Verified	2008-11-08	2009-10-16	Team site	Revision 1	342 d	74%	In progress	
Mast 10	Yes	Verified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mast L5	Yes	Verified	2008-11-12	2009-12-31	Team site	Final draft	414 d	100%	In progress	
<b>Jilin</b>										
Mast 04	Yes	Verified	2008-10-14	2010-03-24	Team site	Revision 1	526 d	100%	In progress	
Mast 05	Yes	Verified	2008-10-15	2009-06-23	Team site	Revision 1	251 d	48%	In progress	
Mast 06	Yes	Verified	2008-10-11	2010-03-26	Team site	Revision 1	531 d	100%	In progress	
Mast 11	Yes	Verified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mast J5	Yes	Verified	2008-10-10	2010-03-25	Team site	Revision 1	512 d	100%	In progress	
<b>Heilongjiang</b>										
Mast 07	Yes	Verified	2008-10-15	2009-11-04	Team site	Revision 1	385 d	84%	In progress	
Mast 08	Yes	Verified	2008-10-12	2009-11-06	Team site	Revision 1	390 d	85%	In progress	
Mast 09	Yes	Verified	2008-10-09	2009-07-13	Team site	Revision 1	277 d	53%	In progress	
Mast 12	Yes	Verified	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mast H5	Yes	Preliminary	2008-10-14	2009-11-03	Team site	Revision 1	385 d	84%	In progress	
Total								74%		

Figure 48. Status of CMA measurements as of 15 June 2010. The “% of 2009” column shows the potential availability of data rather than the actual data recovery rate

Risø DTU is the National Laboratory for Sustainable Energy. Our research focuses on development of energy technologies and systems with minimal effect on climate, and contributes to innovation, education and policy. Risø has large experimental facilities and interdisciplinary research environments, and includes the national centre for nuclear technologies.

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